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ORIGINALNI RAD
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EFEKAT KAZEIN FOSFOPEPTID-AMORFNOG KALCIJUM FOSFATA (CPP-ACP) NA DEMINERALIZACIJU GLEĐI OKO ORTODONTSKIH APARATA: IN VITRO STUDIJA

EFFECT OF CASEIN PHOSPHOPEPTIDE-AMORPHOUS CALCIUM PHOSPHATE (CPP-ACP) TOPICAL AGENTS ON ENAMEL DEMINERALIZATION AROUND ORTHODONTIC BRACES: AN IN VITRO STUDY

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Rezime

Uvod Ortodontski tretman ima brojne prednosti, uključujući i poboljšanje dentalne i facijalne estetike kod pacijenata.

Cilj Cilj rada bio je da se evaluiraju in vitro efekti kazein fosfopeptid-amorfnog kalcijum fosfata (CPP-ACP), sredstva za lokalnu aplikaciju, koje smanjuje demineralizaciju gleđi oko ortodontskih aparata.

Materijal i metode Ispitivanje je obuhvatilo 60 zdravih ekstrahiranih premolara koji nisu imali nikakve kliničke znake demineralizacije. Svi zubi podeljeni su u tri grupe: jedna kontrolna (20 zuba) i dve ispitivane grupe (40 zuba). Zubi (40) su bili podeljeni u 2 grupe prema periodu praćenja – jedna nakon mesec dana, a druga nakon 6 meseci. Zubi su potom premazivani gelom – GC Tooth Mousse u trajanju od 5 minuta tri puta dnevno, a do analiziranja su čuvani u veštačkoj pljuvački. Nakon toga, uzorci su pripremljeni za SEM analizu (JEOL JSM 5300). Spektrometrijom (flame atomic absorption spectrometry – FAAS) je meren procenat Ca i Mg u gleđi. SEM analiza je korišćena za praćenje kiselinom nagrižene površine gleđi tretirane ili netretirane sa CPP-ACP. Dvadeset premolara korišćeno je za praćenje nagriženih površina gleđi pomoću SEM.

Rezultati Prosečne vrednosti sadržaja Ca u gleđi bile su uvećane u ispitivanoj grupi u poređenju sa kontrolnom grupom zuba jedan mesec nakon postavljanja ortodontskog aparata i lokalne primene CPP-ACP. Rezultati su pokazali da SEM analiza detektuje veliki potencijal za remineralizaciju u uzorcima zuba koji su svakodnevno bili izloženi lokalnom dejstvu gela GC Tooth Mousse.

Zaključak: CPP-ACP ima potencijal da remineralizuje dekalcifikovane delove gleđi kod ortodontskih pacijenata. Primena CPP-ACP može da poboljša mineralizaciju zuba tokom ortodontskog tretmana fiksnim aparatima.

Ključne reči: gleđ, ortodontske bravice, demineralizacija, remineralizacija

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Abstract

Introduction Orthodontic treatment has many benefits including the improvement of patient's dental and facial esthetics.

Aim The aim of this study was to evaluate the in vitro effects of a casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) topical agent in reducing enamel demineralization around orthodontic braces.

Material and method This study comprised 60 healthy extracted premolars without any clinical sign of decalcification. The teeth (40) were divided in two groups according to the period of monitoring, after 1 and 6 months. Then they were coated with a topical gel - GC Tooth Mousse for 5 minutes thrice daily, and they have been stored in artificial saliva until analyzing. We measured the percentage of Ca and Mg in the enamel by using the method of flame atomic absorption spectrometry (FAAS). SEM was used to observe the acid-etched enamel surfaces treated with or without CPP-ACP. Twenty premolars were used for ultrastructural examination of the etched enamel surfaces by SEM. The two examined groups were coated with a topical gel - GC Tooth Mousse for 5 minutes thrice daily, and they were stored in artificial saliva for one and six months. After that, the samples were prepared for SEM analysis (JEOL JSM 5300).

Results The mean values of Ca content in enamel were increased in the examined group, compared to the control group of teeth one month after the braces were bonded and topical application with casein phosphopeptide-amorphous calcium phosphate (CPP-ACP). The results indicated that SEM analysis detected the highest remineralization potential in the tooth samples exposed daily to topical gel - GC Tooth Mousse.

Conclusions CPP-ACP has the potential to remineralize areas of enamel decalcification in orthodontic patients. The application of CPP-ACP can improve the mineralization of the teeth during orthodontic treatment with fixed appliance.

Key words: enamel, braces, demineralization, remineralization

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Uvod

Ortodontski tretman ima brojne pozitivne efekte, uključujući poboljšanje dentalne i facijalne estetike pacijenata. Ipak, idealni estetski ishod može biti kompromitovan razvojem demineralizacije oko aparata tokom ortodontskog tretmana. Demineralizacija gleđi koja prati fiksne ortodontske aparate ispituje se godinama i još uvek je problem, uprkos poboljšanju i materijala i tehnika. Tokom korišćenja fiksnih aparata u ortodontskom tretmanu, formiranje belih mrlja čest je propratni efekat. Ortodontske bravice povećavaju retenciju plaka i ostataka hrane na glatkim površinama zuba, koje bi verovatno imale nisku prevalenciju karijesa¹.

Dostupna literatura ukazuje na znatno variranje prevalencije demineralizacije i razvoja belih mrlja tokom fiksnog ortodontskog tretmana. Gorelick i sar.² su ustanovili da prilikom uklanjanja bravica 49.6% pacijenata ima bele mrlje bar na jednom zubu, dok su Sudjalim i sar.³ dobili širok raspon varijacija u svom istraživanju, te je prevalencija belih mrlja bila u rasponu od 2% do 96%. Bez obzira na prevalenciju, postoji slaganje oko toga da demineralizacija i razvoj belih mrlja predstavljaju problem tokom ortodontskog tretmana. Pored toga, ustanovljeno je da bele mrlje mogu biti prisutne godinama. Danas se zna da CPP-ACP može sprečiti demineralizaciju gleđi i podstići remineralizaciju subpovršinskih lezija gleđi. Kako se pokazalo, kompleks kazein fosfopeptid – amorfni kalcijum (CPP-ACP), derivat mlečnih proteina, ima antikariogeni efekat^{4,5,6}. On sprečava demineralizaciju gleđi i podstiče remineralizaciju i deluje puferski na jone slobodnog kalcijuma i fosfata^{7,8}, inkorporirajući na taj način ACP u plak i na površinu zuba⁹. Remineralizovana gleđ ima povećanu rezistenciju na naknadna dejstva kiseline u poređenju sa netretiranom gleđi. Upotreba CPP-ACP u ortodontskoj kliničkoj praksi predložena je za prevenciju belih mrlja i profilaksu karijesa pre postavljanja ortodontskih aparata¹⁰. Kompleksi CPP-ACP deluju kao rezervoar kalcijuma i fosfata, pomažući da se održi stanje super-zasićenja ovim mineralima, što može da podstakne remineralizaciju gleđi. U ovom momentu, kompleksi CPP-ACP dostupni su u različitim gelovima, kremama i penama, a mogu se inkorporirati i u žvakaće gume¹¹.

Introduction

Orthodontic treatment has many benefits including the improvement of patient's dental and facial esthetics. However, the ideal esthetic outcome can be compromised by development of demineralization around the appliances during orthodontic treatment. Enamel demineralization associated with fixed orthodontic appliances has been observed for years and continues to be a problem in spite of the advances in materials and techniques. While using fixed appliances for orthodontic treatments, the formation of white spot lesions is an unaesthetic and common side effect. Bands and braces increase the retention of plaque and food on smooth tooth surfaces that would otherwise tend to have a low prevalence of caries¹.

Published literature shows wide variation in the prevalence of demineralization and white spot development during fixed orthodontic treatment. Gorelick et al.² observed that, at debonding, 49.6% of patients showed white spot formation on at least one tooth, while Sudjalim et al.³ reported a wide variation within their study, with overall prevalence of white spot lesions ranging between 2% and 96%. Irrespective of prevalence, it is agreed upon that demineralization and development of white spot lesions is a problem during orthodontic treatment. Moreover, it is established that white spot lesions may persist for years. In the light of the present state of knowledge, it has been shown that CPP-ACP can prevent enamel demineralization and promote remineralization of enamel subsurface lesions. Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) complex, a milk protein derivative, has been proven to have anticariogenic effects^{4,5,6}. It prevents enamel demineralization and promotes remineralization through buffering free calcium and phosphate ion activities,^{7,8} thereby incorporating ACP into plaque and onto tooth surface and maintaining a state of supersaturation with respect to tooth enamel⁹. Remineralized enamel has an increased resistance to subsequent acid challenge than untreated enamel. The use of CPP-ACP in orthodontic clinical practice has been proposed for white spots prevention and caries prophylaxis before braces bonding procedure¹⁰. The CPP-ACP complexes act as calcium and phosphate reservoir helping to maintain a state of super saturation of these minerals, which can enhance enamel remineralization. Presently, CPP-ACP complexes are available in a variety of gels, creams, and mousses and may also be incorporated into chewing gums¹¹.

Cilj rada bio je da evaluira in vitro efekat lokalno aplikovanog CPP-ACP u redukciji demineralizacije gleđi oko ortodontskih bravica.

The aim of this study was to evaluate the in vitro effects of a casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) topical agent in reducing enamel demineralization around orthodontic braces.

Materijal i metode

Ispitivanjem je obuhvaćeno 60 zdravih, ekstrahiranih premolara, koji nisu imali kliničke znake demineralizacije. Svi zubi podijeljeni su u tri grupe: jedna kontrolna (20 zuba) i dve ispitivane grupe (40 zuba). Svi zubi su očišćeni i presečeni na pola u buko-lingvalnoj ravni pomoću dijamantskog diska. Kontrolni i testirani uzorci, prema tome, potekli su od istih zuba. Adheziv koji je korišćen za postavljanje bravica bio je Con Tec LC (Dentaurum, Germany). Zubi (40) su podijeljeni u dve grupe prema periodu praćenja, nakon jednog i nakon 6 meseci. Zubi su potom lokalno premazani gelom - GC Tooth Mousse u trajanju od 5 minuta tri puta dnevno, a onda su do analiziranja čuvani u veštačkoj pljuvački (20 mmol/l NaHCO₃, 3 mmol/l NaH₂PO₄ i 1 mmol/l CaCl₂, neutralan pH). Procenat Ca i Mg u gleđi meren je spektrometrijom (flame atomic absorption spectrometry – FAAS) u aparatu Varian Spectra AA 55 B^{12,13}. Pre analize, optimizirani su instrumentalni parametri radi bolje preciznosti i osjetljivosti (Tabela 1). Sadržaj istraživanih elemenata u zubnoj gleđi određivan je pomoću FAAS nakon mineralizacije u mikrotalasnom sistemu firme Milestone, model Ethos Touch Control (Tabela 2).

Material and method

This study comprised 60 healthy extracted premolars without any clinical sign of decalcification. All teeth were cleaned and cut in half buccolingually with a diamond disc. Thus, the control and test specimens were obtained from the same teeth. The adhesive used for bonding braces was Con Tec LC (Dentaurum, Germany). The teeth (40) were divided in two groups according to the period of monitoring, after 1 and 6 months. Then they were coated with a topical gel - GC Tooth Mousse for 5 minutes thrice daily, and they have been stored in artificial saliva (20 mmol/l NaHCO₃, 3 mmol/l NaH₂PO₄ and 1 mmol/l CaCl₂, neutral pH) until analyzing. We measured the percentage of Ca and Mg in the enamel by using the method of flame atomic absorption spectrometry (FAAS), with a Varian Spectra AA 55 B atomic absorption spectrometer^{12,13}. Before the analysis, instrumental parameters for better precision and sensibility were optimized (Table 1). The content of the investigated elements in the teeth enamel was determined by FAAS after mineralization in a microwave digestion system from Milestone, model Ethos Touch Control (Table 2).

Tabela 1. Optimalni instrumentalni parametri za određivanje Ca i Mg pomoću FAAS
Table 1. Optimal instrumental parameters for Ca and Mg determination by FAAS

Parametri/element Parameters/ element	Ca	Mg
Talasna dužina/nm Wavelength/nm	422.7	285.2
Otvor-prerez/nm Slit/nm	0,5	0,2
Struja lampe /mA Lamp current/mA	10	4

Tabela 2. Program mineralizacije uzoraka zuba
Table 2. Tooth sample mineralization program

Faza/korak Step	Temperatura/°C Temperature/°C	Vreme/min Time/min	Snaga/W Power/W	Pritisak/bar Pressure/bar
1	160	10	300	15
2	210	10	450	15

Konstruisanje kalibracionog dijagrama

Kalibracioni dijagram je konstruisan korišćenjem metode standardnih rastvora. Koristeći regresionu analizu, dobijeni su funkcionalni odnosi između masene koncentracije i apsorpcije Ca i Mg. Korišćeni su standardni rastvori Ca i Mg sa koncentracijom 1 mg/L. Analitička zavisnost koncentracione apsorpcije od Ca je data jednačinom: $A = 0,0078 \cdot \gamma(\text{Ca})/\mu\text{g/ml}$. Koeficijent korelacije bio je 0,992.

SEM analiza

SEM analiza je korišćena za opserviranje kiselinom nagriženih površina gleđi, tretiranih ili netretiranih sa CPP-ACP. Za ultrastrukturno ispitivanje nagriženih površina gleđi pomoću SEM korišćeno je 20 premolara. Krunice su odsečene od ostatka zuba dijamantskim svrdlom na spoju cementa i gleđi, a svaka krunica presečena je longitudinalno u okluzogingivalnom pravcu da bi se dobile dve bukalne površine gleđi. Svaka od površina dobijenih od istog zuba nasumično je stavljena u jednu od dve eksperimentalne grupe. Zubi u dve ispitivane grupe premazivane su gelom - GC Tooth Mousse tokom 5 minuta tri puta dnevno, a onda čuvani u veštačkoj pljuvački jedan mesec i 6 meseci. Nakon toga, uzorci su pripremljeni za SEM analizu (JEOL JSM 5300) korišćenjem tehnike prskanja (sputter) u vakuumskom evaporatoru. Odgovarajući deo površine gleđi analiziran je da bi se utvrdile mikromorfološke promene u strukturi gleđi na mestu na kojem su bile fiksirane bravice.

U statističkoj analizi, najpre je korišćena jednostrana analiza varijance (ANOVA), a nakon nje i Tukey test, da bi utvrdili da li među grupama postoje značajne razlike.

Rezultati

U ispitivanim grupama zabeležene su statistički značajne razlike u srednjim vrednostima sadržaja Ca u gleđi nakon tretmana posle jednog meseca i posle 6 meseci (analiza varijance $F=3,710$; $p=0,0284$) (Tabela 3).

Construction on calibration diagram

Calibration diagram was constructed by using of the method of standard solutions. Using regression analysis, functional relationships between mass concentration and absorbance of Ca and Mg were obtained. Standard solutions of Ca and Mg with concentration of 1 mg/L were used. Analytical dependence on concentration absorbance on Ca is given by the equation: $A = 0,0078 \cdot \gamma(\text{Ca})/\mu\text{g/ml}$. Correlation coefficient was 0,992.

SEM Observations

SEM was used to observe the acid-etched enamel surfaces treated with or without CPP-ACP. Twenty premolars were used for ultrastructural examination of the etched enamel surfaces by SEM. The crowns were sectioned from the roots with a diamond bur at the buccal cement enamel junction, and each crown was cut longitudinally in an occlusogingival direction to obtain two buccal enamel surfaces. Each surface obtained from the same tooth was randomly allocated to one of two experimental groups. The two examined groups were coated with a topical gel - GC Tooth Mousse for 5 minutes thrice daily, and stored in artificial saliva for one and six months. After that, the samples were prepared for SEM analysis (JEOL JSM 5300), using sputter technique in a vacuum evaporator. The appropriate area of enamel surface was analyzed in order to determine micro morphology changes in the structure of the enamel, on the place of previous braces fixation.

For statistical evaluation, one-way analysis of variance (ANOVA) followed by Tukey's test were initially used to see if there was a significant difference between the groups.

Results

In the examined group of teeth (Table 3) there were statistically significant differences of Ca content mean values in enamel after treatment at one and six months (Analysis of variance $F=3,710$; $p=0,0284$).

Tabela 3. Procenat Ca u gleđi u ispitivanim grupa
Table 3. Percentage of Ca in enamel in the examined group

Vreme time	\bar{X}	SD	N
1 mesec 1 month	25,19	2,02	30
6 meseci 6 months	24,57	2,45	30

F=3,710; p=0,0284

Srednje vrednosti sadržaja Ca u gleđi ispitivane i kontrolne grupe zuba jedan mesec nakon postavljanja proteze i lokalne primene CPP-ACP prikazane su u Tabeli 4.

The mean values of Ca content in enamel of the examined and control group of teeth one month after the braces were bonded and topical application with casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) are shown in Table 4.

Tabela 4. Poređenje sadržaja Ca u gleđi u ispitivanim i kontrolnoj grupi (%)
Table 4. Comparison of Ca content in enamel between the examined and control group (%)

Vreme time	Ispitivana grupa examined group		Kontrolna grupa control group		t	p
	\bar{X}	SD	\bar{X}	SD		
1 mesec 1 month	25,19	2,02	23,32	2,34	3,318	0,00156*
6 meseci 6 months	24,57	2,45	23,45	2,41	1,777	0,0807

*statistički značajne razlike / *statistically significant differences

Vrednosti su bile veće u ispitivanim grupama u poređenju sa kontrolnom grupom zuba. Nakon mesec dana, primećena je statistički značajna razlika u vrednostima Ca u gleđi između ispitivanih i kontrolne grupe. Nakon 6 meseci tretmana, beleži se razlika, mada ne statistički značajna, u srednjim vrednostima Ca u gleđi između ispitivanih i kontrolne grupe.

U ispitivanim grupama nije bilo statistički značajnih razlika u srednjim vrednostima sadržaja Mg u gleđi nakon tretmana posle jednog meseca i posle 6 meseci (analiza varijance F=5,031; p=0,0085) (Tabela 5). Srednje vrednosti sadržaja Mg u gleđi ispitivanih grupa i kontrolne grupe zuba jedan mesec nakon postavljanja proteze i lokalne aplikacije CPP-ACP prikazane su u Tabeli 6. Nakon mesec dana, nije bilo statistički značajne razlike u srednjim vrednostima Mg u gleđi u ispitivanoj i kontrolnoj grupi. Nakon 6 meseci tretmana, nije bilo statistički značajnih razlika u srednjim vrednostima Mg u gleđi u ispitivanoj i kontrolnoj grupi.

Reprezentativni SEM prikazi uzoraka nagrižene gleđi prethodno tretiranih sa i bez CPP-ACP predstavljeni su na Figurama 1-3.

These values were increased in the examined group, compared to the control group of teeth. After one month, a statistically significant difference of Ca values in enamel between the examined and control groups was noticed. After six-month treatment were differences, but not statistically significant of the Ca mean values in enamel between the examined and control group.

In the examined group of teeth (Table 5), there were statistically significant differences of Mg content mean values in enamel after treatment at one and six months (Analysis of variance F=5,031; p=0,0085). The mean values of Mg content in enamel of the examined and control group of teeth one month after the braces were bonded and topical application with casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) are shown in Table 6. After one month, no statistically significant difference of the Mg mean values in enamel between the examined and control group was found. After six-month treatment, there were statistically significant differences of the Mg mean values in enamel between the examined and control group.

Table 5. Procenat Mg u gleđi u ispitivanim grupama
Table 5. Percentage of Mg in enamel in the examined group

Vreme time	\bar{X}	SD	N
1 mesec 1 month	0,323	0,074	30
6 meseci 6 months	0,388	0,078	30

F=5,031; p=0,0085

Table 6. Poređenje sadržaja Mg u gleđi u ispitivanim i kontrolnoj grupi (%)
Table 6. Comparison of Mg content in enamel between the examined and control group (%)

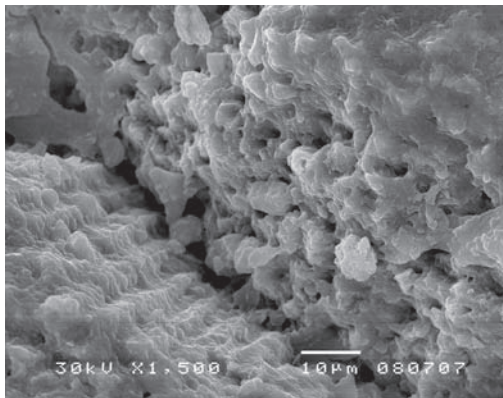
Vreme time	Ispitivana grupa examined group		Kontrolna grupa control group		t	p
	\bar{X}	SD	\bar{X}	SD		
1 mesec 1 month	0,323	0,074	0,306	0,069	0,914	0,36449
6 meseci 6 months	0,388	0,078	0,357	0,055	2,012	0,04884*

*statistički značajne razlike / *statistically significant differences

U kontrolnoj grupi (veštačka pljuvačka), konfiguracija topografije gleđi očigledno je imala porozne defekte (Slika 1a; uvećanje 1500x). Pri još jačem uvećanju (3500x), poroznost je bila još evidentnija, a oko poroznih polja mogle su se uočiti linije mineralizacije (Slika 1b).

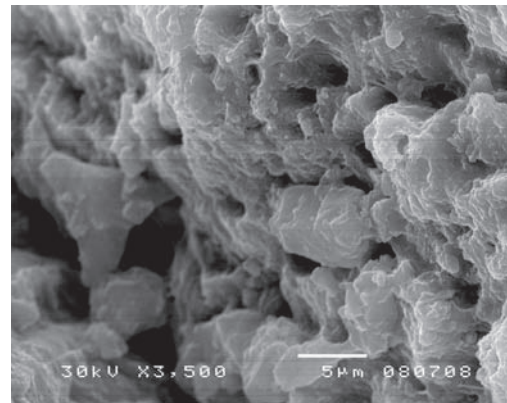
Representative SEM images of the etched enamel specimens pretreated with and without CPP-ACP are shown in Figures 1 - 3.

In the control group (artificial saliva), the configuration of enamel topography was presented apparent with certain porous defects (Figure 1a; 1000× magnification). At a higher



Slika 1a. Porozni defekti gleđi, kontrolna grupa.
SEM (uvećanje x1500)

Figure 1a. Porous defects of enamel, control group.
SEM (magnification x1500)



Slika 1b. Porozni defekti gleđi, kontrolna grupa. SEM
(uvećanje x3500)

Figure 1b. Porous defects of enamel, control group.
SEM (magnification x3500)

U ispitivanoj grupi (nakon jednog meseca tretmana sa CPP-ACP), evidentna je poroznost interprizmatične supstance, kao i polja remineralizacije (Slika 2a; uvećanje 1500x). Pri jačem uvećanju (3500x), u istoj grupi su se uz poroznost gleđi mogle videti određene oblasti kalcifikacije (Slika 2b).

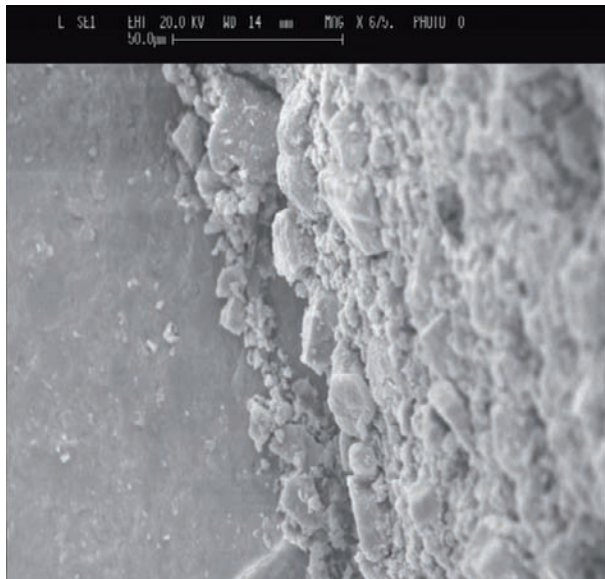
magnification of 2000×, the porosities were more evident and faint lines of mineralization can be seen in the same group and around the porosities (Figure 1b).

In the examined group (after treatment of one month with CPP-ACP), interprismatic substances with porosities and areas of remineralization were evident (Figure 2a; 1500× magni-

U ispitivanoj grupi (nakon šestomesečnog tretmana sa CPP-ACP), evidentne su oblasti kalcifikovanih depozita uz porozne defekte (Slika 3a; uvećanje 3500x). Pri jačem uvećanju (5000x), u istoj grupi su se uz poroznost mogle primetiti oblasti mineralizovanih depozita i polja kalcifikacije (Slika 3b).

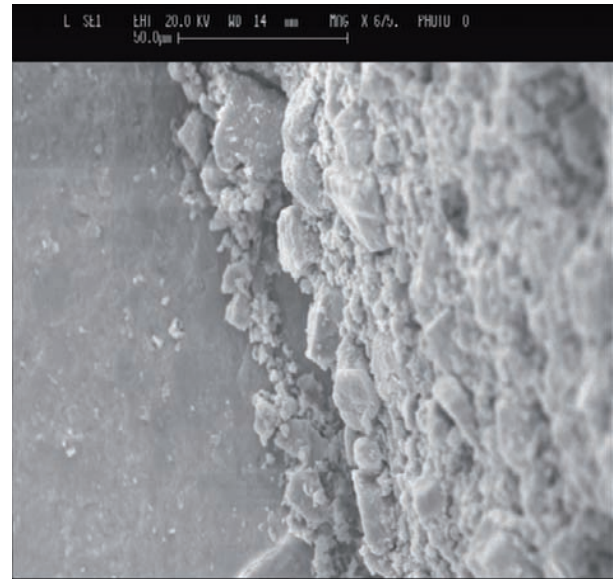
At a higher magnification of 3500×, certain areas of calcifications along the porosities were seen in the same group (Figure 2b).

In the examined group (after the six-month treatment with CPP-ACP), areas of calcified deposits concentrated along the porous defects were evident (Figure 3a; 3500× magnification). At a higher magnification of 5000×, discernable areas of mineralized deposits and certain areas of calcifications along the porosities were seen in the same group (Figure 3b).



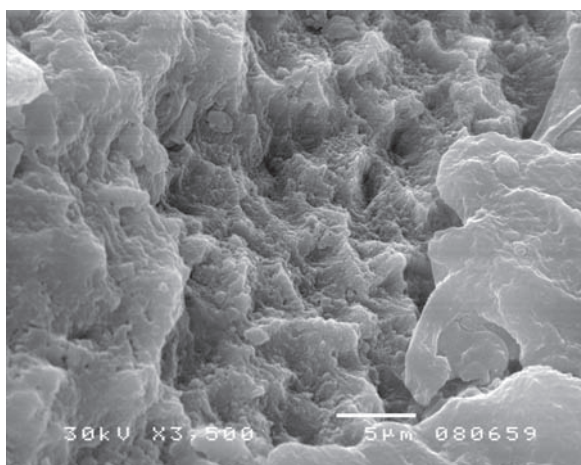
Slika 2a. Polja remineralizacije porozne interprizmatične supstance, ispitivana grupa nakon jednomesečnog tretmana sa CPP-ACP. SEM (uvećanje x1500)

Figure 2a. Interprismatic substances with porosities and areas of remineralization, examined group after treatment of 1 month with CPP-ACP. SEM (magnification x1500)



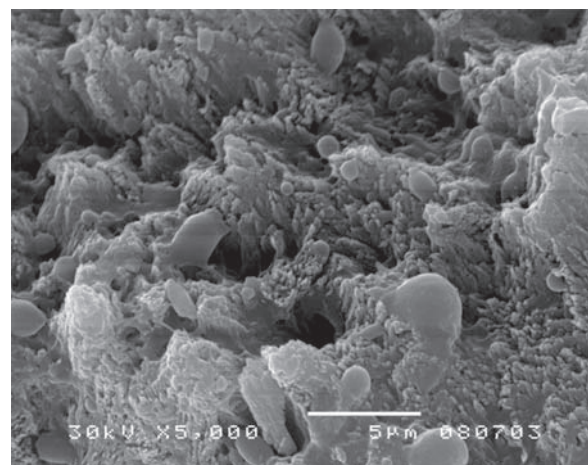
Slika 2b. Polja remineralizacije porozne interprizmatične supstance, ispitivana grupa nakon jednomesečnog tretmana sa CPP-ACP. SEM (uvećanje x3500)

Figure 2b. Interprismatic substances with porosities and areas of remineralization, examined group after treatment of 1 month with CPP-ACP. SEM (magnification x3500)



Slika 3a. Kalcifikovan depozit uz porozne defekte gleđi, ispitivana grupa nakon šestomesečnog tretmana sa CPP-ACP. SEM (uvećanje x3500)

Figure 3a. Areas of calcified deposits concentrated along the porous defects, examined group after treatment of 6 months with CPP-ACP. SEM (magnification x3500)



Slika 3b. Kalcifikovan depozit uz porozne defekte gleđi, ispitivana grupa nakon šestomesečnog tretmana sa CPP-ACP. SEM (uvećanje x5000)

Figure 3b. Areas of calcified deposits concentrated along the porous defects, examined group after treatment of 6 months with CPP-ACP. SEM (magnification x5000)

Diskusija

Opšte je prihvaćeno da postavljanje fiksnih ortodontskih aparata stvara retenciona mesta za plak i otežava čišćenje zuba. Neravne površine bravica, traka, žica i drugih elemenata, takođe ograničavaju prirodne mehanizme čišćenja kao što su pokretanje oralne muskulature i pljuvačke. U prisustvu ugljenih hidrata u ustima, snižava se pH plaka i ubrzava njegova akumulacija i sazrevanje. Te promene, pogoduju kolonizaciji acidogenih bakterija, kao što su *Streptococcus mutans* i *Lactobacilli*. Međutim, nivo bakterija se značajno smanjuje nakon 6-15 nedelja od uklanjanja fiksnog ortodontskog aparata.

U jednom od prvih kliničkih ispitivanja CPP-ACP kreme, korišćene specijalno za tretman belih mrlja nastalih nakon nošenja fiksnih ortodontskih aparata, Bailey i sar.¹⁴ su zaključili da korišćenje CPP-ACP kreme pospešuje regresiju bele mrlje u poređenju sa placebom. Ipak, u novijim kliničkim istraživanjima došlo se do rezultata koji nisu tako dobri. U svojoj kliničkoj studiji na 54 ispitanika, Beerens i sar.¹⁵ poredi CPP-ACP pastu koja sadrži fluorid sa kontrolnom pastom. Nakon tromesečnog perioda tretmana, ne nalaze nikakvu prednost korišćenja fluoridne CPP-ACP paste u odnosu na redovnu oralnu higijenu u smislu regresije bele mrlje, mereno pomoću QLF. CPP-ACP kompleks deluje kao „nosač“ kalcijuma i fosfata, pri čemu ih transportuje do površine zuba i skladišti u plak i pelikulu. Redukcija pH dovodi do oslobađanja jona kalcijuma i fosfata, čime se stimuliše remineralizacija¹⁶.

Kazein fosfopeptidi (CPP) sadrže multifosfoserilne sekvence, koje imaju sposobnost da stabilizuju kalcijum fosfat u nano-komplekse u rastvoru, u obliku amorfnog kalcijum fosfata (ACP). Ovi nano-kompleksi (CPP-ACP) ostaju veoma mali i imaju dve funkcije: mogu se lokalizovati na površini zuba i sprečiti demineralizaciju gleđi, a takođe su dovoljno mali da se probiju duboko u poroznu gleđ i remineralizuju površinu gleđnih kristala. U isto vreme, CPP-ACP stupa u interakciju sa dostupnim jonima fluorida i produkuje amorfnu kalcijum fluorid fosfat, koji se pomoću CPP može taložiti na površini zuba. Rezultat primene CPP-ACP jeste duboka remineralizacija, čime se eliminiše poroznost gleđi. Ova studija je urađena kako bi se utvrdio remineralizacioni potencijal CPP-ACP. Molekuli CPP sadrže klaster fosfoseril ostataka

Discussion

It is generally accepted that the insertion of fixed orthodontic appliances creates stagnation areas for plaque and makes tooth cleaning more difficult. The irregular surfaces of braces, bands, wires, and other attachments also limit naturally occurring self-cleansing mechanisms, such as the movement of the oral musculature and saliva. This in turn encourages a lower plaque pH in the presence of carbohydrates and accelerates the rate of plaque accumulation and plaque maturation. These changes in the local environment appear to favor colonization of aciduric bacteria such as *Streptococcus mutans* and *Lactobacilli*. However, such microbial levels were found to decrease significantly to levels comparable with age matched controls, 6 to 15 weeks into a retention phase, after the removal of fixed appliances.

In one of the first clinical trials of CPP-ACP cream used specifically for treatment of post-orthodontic WSLs, Bailey et al.¹⁴ reported that use of CPP-ACP cream enhanced the regression of WSLs compared with placebo. However, more recent clinical investigations show less promising results. In a clinical study, Beerens et al.¹⁵ compared a fluoride-containing CPP-ACP paste with a control paste in 54 subjects. After a three-month treatment period, they found no advantage for use of the fluoridated CPP-ACP paste over regular oral hygiene in WSLs regression as measured by QLF. The CPP-ACP complex acts as a vehicle for calcium and phosphate, transporting it to the tooth surface and localizing it in plaque and salivary pellicles. A reduction in pH results in a release of calcium and phosphate ions, which act to promote remineralization¹⁶.

Casein phosphopeptides (CPP) contain multiphosphoserine sequences and these have the ability to stabilize calcium phosphate in nano-complexes in solution in the form of amorphous calcium phosphate (ACP). These nano complexes (CPP-ACP) remain very small and they have two effective functions. They can localize at the tooth surface and prevent enamel demineralization and they are also small enough to be able to penetrate deep into the porous enamel and remineralize the surface of the enamel crystals. At the same time, the CPP-ACP will interact with available fluoride ions to produce an amorphous calcium fluoride phosphate and

koji znatno povećavaju očiglednu rastvorljivost kalcijum fosfata stabilizujući amorfnu kalcijum fosfat u neutralnim i alkalnim uslovima. CPP može da stabilizuje preko 100 puta više kalcijum fosfata nego što je normalno moguće u vodenim rastvorima pri neutralnom ili alkalnom pH, pre nego što dođe do spontane precipitacije. Uz to, CPP-ACPF poseduje fluorid. Istraživanja su pokazala da je remineralizacija malih lezija niskim dozama fluorida efikasnija¹⁷.

U ovoj in vitro studiji ispitivan je procenat kalcijuma, njegov efekat na demineralizaciju gleđi i promene koje se opažaju na površini gleđi nakon postavljanja fiksnog ortodontskog aparata (Con Tec LC Dentaurum) i lokalne aplikacije GC Tooth Mousse. Rezultati dobijeni u radu ukazuju na veoma visok procenat Ca u gleđi u ispitivanoj grupi za prvi ispitivani period (mesec dana). SEM prikazi ove tri grupe ukazuju na remineralizaciju sa CPP-ACP, uz najveću količinu mineralnih depozita nakon 6 meseci tretmana sa CPP-ACP.

Zaključak

CPP-ACP ima potencijal da remineralizuje dekalifikovanu gleđ kod pacijenata sa fiksnim ortodontskim aparatima. Međutim, kako su pacijenti sa demineralizovanom gleđi uglavnom oni sa lošom oralnom higijenom, motivacija takvih osoba za održavanjem pravilne oralne higijene od ključnog je značaja u prevenciji demineralizacije gleđi, te se CPP-ACP može koristiti kao dopunska terapija. Primena CPP-ACP može poboljšati mineralizaciju zuba tokom ortodontskog tretmana fiksnim aparatima.

this can be stabilized by the CPP on the tooth surface. The result from the application of CPP-ACP is remineralization in depth, thus eliminating the porosity in the enamel and restoring the light properties and translucency. This study was undertaken to determine the remineralization potential of CPP-ACP. The CPP molecules contain a cluster of phosphoserine residues that markedly increase the apparent solubility of calcium phosphate by stabilizing amorphous calcium phosphate under neutral and alkaline conditions. CPP can stabilize over 100 times more calcium phosphate than is normally possible in aqueous solution at neutral or alkaline pH before spontaneous precipitation occurs. CPP-ACPF has, in addition, fluoride. Studies have shown that remineralization of small lesions with low-dose fluoride therapy is more efficient¹⁷.

In this in vitro study we examined the percentage of calcium, its effect on enamel demineralization, and the alterations that were observed on the enamel surface after the use of orthodontic bonding system (Con Tec LC Dentaurum) and topical application of dental cream GC Tooth Mousse. The results obtained in this study showed a remarkably high percentage of Ca in enamel in the examined group for the first examined period (at one month). The SEM images of the three groups suggest remineralization with the CPP-ACP showing the greatest amount of mineral deposits, after the six-months treatment with CPP-ACP.

Conclusions

CPP-ACP has the potential to remineralize areas of enamel decalcification in orthodontic patients. However, since patients with enamel decalcification are generally those with poor oral hygiene, good oral hygiene instruction is essential in preventing enamel decalcification in orthodontic patients, with CPP-ACP used as an adjunct therapy.

The application of CPP-ACP can improve the mineralization of the teeth during orthodontic treatment with fixed appliance.

LITERATURA / REFERENCES

1. Chapman JA, Roberts WE, Eckret GJ, Kula KS, Gonzalez-Cabezas C. Risk factors for incidence and severity of white spot lesions during treatment with fixed orthodontic appliance. *Am J Orthod Dentofacial Orthop* 2010; 138:188-94.
2. Gorelick L, Geiger AM, Gwinnett AJ. Incidence of white spot formation after bonding and banding. *Am J Orthod* 1982; 81(2):93-8.
3. Sudjalim TR, Woods MG, Manton DJ. Prevention of white spot lesions in orthodontic practice: a contemporary review. *Aust Dent J* 2006; 51(4):284-9.
4. Reynolds EC, Cain CJ, Webber FL, Black CL, Riley PF, Johnson IH. Anticariogenicity of calcium phosphate complexes of tryptic casein phosphopeptides in the rat. *J Den Res* 1995; 74:1272-9.
5. Reynolds EC. Remineralization of enamel subsurface lesions by casein phosphopeptide-stabilized calcium phosphate solutions. *J Den Res* 1997; 76:1587-95.
6. Reynolds EC. Anticariogenic complexes of amorphous calcium phosphate stabilized by casein phosphopeptides: a review. *Special Care in Dentistry* 1998;8:8-16.
7. Reynolds EC, Black CL, Cai F, Cross KJ, Eakins D, Huq NL. Anticariogenic casein phosphopeptide-amorphous calcium phosphate. *J Clin Dent* 1999; 10:86-8.
8. Kumar VLN, Itthagarun A, King NM. The effect of casein phosphopeptide-amorphous calcium phosphate on remineralization of artificial caries-like lesions: an in vitro study. *Aus Den J* 2008; 53:34-40.
9. Iijima Y, Cai F, Shen P, Walker G, Reynolds C, Reynolds EC. Acid resistance of enamel sub surface lesions remineralized by a sugar free chewing gum containing casein phosphopeptide-amorphous calcium phosphate. *Caries Res* 2004; 38:551-6.
10. Reynolds EC, Cai F, Shen P, Walker GD. Retention in plaque and remineralization of enamel lesions by various forms of calcium in a mouthrinse or sugar-free chewing gum. *J Den Res* 2003; 82:206-11.
11. Shen P, Cai F, Nowiciki A, Vincent J, Reynolds EC. Remineralization of enamel sub surface lesions by sugar free chewing gum containing casein phosphopeptideamorphous calcium phosphate. *J Den Res* 2001; 80:2066-70.
12. Flame Atomic Absorption Spectrometry, Analytical Methods, Varian, Australia Pty Ltd, Publication No 85-100009-00 Revised March 1989.
13. Tsalev DL, Zaprinov ZK. Atomic Absorption Spectrometry in Occupational and Environmental Health Practice. Volume I. Analytical Aspects and Health Significance, Boca Raton, Florida: CRC Press, 1983.
14. Bailey DL, Adams GG, Tsao CE. Regression of postorthodontic lesions by a remineralizing cream. *J Dent Res* 2009; 88:1148-1153.
15. Beerens MW, Van Der Veen MH, Van Beek H, Cate Ten JM. Effects of casein phosphopeptide amorphous calcium fluoride phosphate paste on white spot lesions and dental plaque after orthodontic treatment: a 3-month follow-up. *Eur J Oral Sci* 2010; 118:610-7.
16. Mazzaoui SA, Burrow MF, Tyas MJ, Dashper SG, Eakins D, Reynolds EC. Incorporation of phosphopeptide-Amorphous Calcium phosphate into glass ionomer cement. *J Dent Res* 2003; 82(11):914-8.
17. Srinivasan N, Kavitha M, Loganathan SC. Comparison of the remineralization potential of CPP-ACP and CPP-ACP with 900 ppm fluoride on eroded human enamel: An in situ study. *Arch Oral Biol* 2010; 55:541-4.

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KOREKCIJE U PROTOKOLU IRIGACIJE KANALA KORENA ZUBA - PRIMUM NON NOCERE

CORRECTIONS OF THE ROOT CANAL IRRIGATION PROTOCOL - PRIMUM NON NOCERE

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Sažetak

Endodontski irigansi imaju važnu ulogu u eliminaciji mikroorganizama iz kanalnog sistema zuba, rastvaranju organskih tkiva, uklanjanju debrisa i razmaznog sloja. Natrijum hipohlorit (NaOCl) predstavlja snažno antiseptično sredstvo koje rastvara organski deo dentina, razgrađuje vitalno i nekrotično tkivo i neutrališe toksične produkte. Njegov antibakterijski efekat raste sa povećanjem koncentracije. Zbog neadekvatnog površinskog napona, NaOCl ima ograničen pristup uskim i akcesornim kanalčićima. Hlorheksidin (CHX) ima sličan spektar delovanja, ali može ispoljiti aktivnost i prema NaOCl rezistentnim sojevima bakterija. Postiže efikasnu dezinfekciju kanala zbog osobine supstantivnosti, tj. postepenog i prolongiranog dejstva na mikroorganizme. Za razliku od NaOCl, CHX nije u stanju da rastvori organski materijal unutar kanala korena. Etilen-diamin-tetraacetat (EDTA) uklanja neorganski deo dentinskog zida olakšavajući prolaz endodontskim instrumentima. Ovaj irigans ne deluje na organski deo razmaznog sloja i ne poseduje antimikrobna svojstva. Izgleda da nijedan irigans nije u stanju da sam ispuni sve potrebne zahteve, zbog čega je neophodna njihova kombinovana upotreba. Istraživanja su pokazala da između pojedinih iriganasa postoje interakcije koje su nepoželjne i mogu kompromitovati endodontsku terapiju.

Mešavina NaOCl i CHX dovodi do prebojavanja zuba i stvaranja narandžasto-braon precipitata, koji ostaje na dentinskom zidu ili prelazi u periapeksno tkivo. Kombinacija CHX i EDTA takođe stvara talog. Ovaj precipitat smanjuje permeabilnost, remeti hermetičku opturaciju kanala i može delovati kao hemijski razmazni sloj. Ustanovljeno je da se sastoji od para-hloranilina, za koga je eksperimentalno dokazano da ima toksično dejstvo na tkiva oko vrha korena zuba. Jednostavne korekcije u protokolu irigacije kanala korena zuba mogu sprečiti pojavu neželjenih reakcija između endodontskih iriganasa.

Ključne reči: endodontski irigansi, interakcije, precipitat

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Abstract

Endodontic irrigant play an important role in the elimination of microorganisms from the root canal system, dissolving organic tissue, removing of debris and the smear layer. Sodium hypochlorite (NaOCl) is a powerful antiseptic agent which dissolves the organic part of dentin, vital and necrotic tissue and neutralizes toxic products. Its antibacterial effect increases with increasing concentration. Due to inadequate surface tension, NaOCl has restricted access to narrow and accessory canals. Chlorhexidine (CHX) has an antibacterial efficacy comparable to NaOCl, while being effective against certain NaOCl resistant bacterial strains. Effective root canal disinfection is achieved due to substantivity, i.e. continued and prolonged antimicrobial effect. Unlike NaOCl, it is not able to dissolve organic material within the root canal. Ethylenediamine-tetra-acetate (EDTA) removes the inorganic part of the dentinal wall facilitating the passage of endodontic instruments. It does not act on the organic smear layer and has not antimicrobial properties. It seems that no irrigant alone can fulfill all the necessary requirements, so their combined use is necessary. Studies have shown that there are interactions between some irrigants, which are undesirable and may compromise endodontic therapy. A mixture of NaOCl and CHX leads to staining of the teeth and the creation of an orange-brown precipitate, which either remains in the dentinal wall or exceeds to the periapical tissues. CHX and EDTA combination also produces a precipitate. This precipitate reduces permeability, disrupts hermetic obturation and can act as a chemical smear layer. It was found that the precipitate consist of the para-chloroaniline, which has been experimentally shown to have toxic effects on the tissue around the root apex. Simple adjustments in the irrigation protocol can prevent the occurrence of adverse reactions between endodontic irrigants.

Key words: endodontic irrigants, interactions, precipitate

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Uvod

Endodontski irigansi imaju važnu ulogu u eliminaciji mikroorganizama iz kanalnog sistema zuba, rastvaranju organskih tkiva, uklanjanju debrisa i razmaznog sloja¹⁻⁴.

Mnoga istraživanja su pokazala da između pojedinih iriganasa postoje interakcije koje su nepoželjne i mogu kompromitovati endodontsku terapiju^{5,6}.

Cilj ovog istraživanja bio je razmatranje podataka iz literature o interakcijama koje nastaju kada se natrijum hipohlorit, hlorheksidin, etilen-diamin-tetra-acetat i limunska (ili maleinska) kiselina koriste zajedno u toku endodontske terapije.

Za dobijanje informacija o interakcijama između endodontskih iriganasa urađeno je pretraživanje literature preko PubMed baze podataka i ključnih reči: interakcija i endodontski irigansi, natrijum hipohlorit i hlorheksidin, natrijum hipohlorit i EDTA, hlorheksidin i EDTA, NaOCl i limunska (ili maleinska kiselina), helatni agens i hlorheksidin". Pretraživanje literature urađeno je u junu 2013. godine.

Irigansi u endodonciji

Najčešće korišćen irigans je natrijum hipohlorit (NaOCl), koji predstavlja snažno antiseptično sredstvo sa sposobnošću rastvaranja organskog dela dentina, razgradnje vitalnog i nekrotičnog tkiva, neutralizacije toksičnih produkata i lubrikacije^{1,2}. Uklanjajući debris, ovaj irigans sprečava „zatrpavanje“ apeksnog dela kanala strugotinama dentina i ostacima mekih tkiva, kao i istiskivanje inficiranog materijala u periapeksni prostor¹⁻³.

Svoje antimikrobno dejstvo NaOCl ostvaruje preko hipohlorne kiseline, koja rastvara organsko tkivo i oslobađa hlor. Reakcijom između hlora i amino-grupa formiraju se hloramini koji remete ćelijski metabolizam. Hlor ispoljava antimikrobno dejstvo tako što dovodi do ireverzibilne oksidacije SH grupa esencijalnih bakterijskih enzima^{4,7}.

Iako se u literaturi sreću podaci da se NaOCl u endodontskoj terapiji može koristiti u koncentracijama od 0,5%, 1%, 1,25%, 2,6% i 5,25%, još uvek ne postoji usaglašeno mišljenje u vezi sa ovom temom. Činjenica je da antibakterijski efekat ovog irigansa raste sa

Introduction

Endodontic irrigants play an important role in the elimination of microorganisms from the root canal system of the tooth, dissolving organic tissue, removing of debris and the smear layer¹⁻⁴.

Many studies have demonstrated certain irrigants interactions that are undesirable and may compromise endodontic therapy^{5,6}.

The aim of this study was to consider the literature data on the interactions occurring when sodium hypochlorite, chlorhexidine, ethylene-diamine-tetraacetate and citric (or maleic) acid are used together during endodontic treatment.

In order to obtain information about the interactions among the endodontic irrigants, literature search was performed through PubMed, and key words: interaction and endodontic irrigants, sodium hypochlorite and chlorhexidine, sodium hypochlorite and EDTA, chlorhexidine and EDTA, NaOCl and citric (or maleic acid), chelating agents and chlorhexidine. Literature search was performed in June 2013.

Irrigating solutions in endodontics

The most commonly used irrigant is sodium hypochlorite (NaOCl), which is a powerful antiseptic agent with the ability to dissolve organic part of dentine, decompose vital and necrotic tissue, neutralize toxic products and lubrication^{1,2}. Removing debris, NaOCl prevents packing of the hard and soft tissue in the apical root canal and extrusion of infected material into the periapical area¹⁻³.

Antimicrobial effect of NaOCl is achieved through hypochloric acid which in contact with organic tissue acts as a solvent and releases chlorine. Reaction between chlorine and the amino group (NH) forms chloramines that interfere in cell metabolism. Chlorine has an antimicrobial action, leading to an irreversible oxidation of SH groups of essential bacterial enzymes^{4,7}.

Although the literature provides information that sodium hypochlorite in endodontic therapy can be used in concentrations of 0.5%, 1%, 1.25%, 2.6% and 5.25%, there is still no agreed opinion about this topic. The fact that the antibacterial effect of irrigant increases with increasing concentration, so that the full-strength concentration (5.25%) is extremely effective against microorganisms, but also very toxic. Since the

povećanjem koncentracije, tako da je najveća koncentracija (5,25%) izuzetno efikasna protiv mikroorganizama, ali, istovremeno i veoma toksična. S obzirom da je aktivnost NaOCl vezana za količinu slobodnog hloridnog anjona, smanjenje koncentracije može se kompenzovati povećavanjem volumena. To znači da je za redukciju bakterija u kanalnom sistemu mnogo važnija količina NaOCl nego njegova koncentracija. Takođe, zagrevanje i primena aparata sa ultrazvukom mogu povećati aktivnost rastvora^{1,2,8}.

Literaturni podaci ukazuju na značajno manju antimikrobnu aktivnost NaOCl u in vivo uslovima. Pretpostavlja se da je razlog tome neadekvatan površinski napon, što ograničava pristup lateralnim i apeksnim ramifikacijama, uskim i akcesornim kanalićima koji ostaju slabo ili nedovoljno tretirani. Pored toga, prisustvo organskih materija (ostaci tkiva, zapaljenski eksudat, dentinski kolagen, mikrobna biomasa) troši NaOCl i slabi njegovo dejstvo¹.

Imajući u vidu toksičnost visokih koncentracija NaOCl, nemogućnost pristupa svim delovima kanalnog sistema, redukciju aktivnosti in vivo, izgleda da ne postoji opravdanje za korišćenje NaOCl kao endodontskog irigansa u koncentraciji višoj od 1%².

Hlorheksidin (CHX) ima sličan spektar delovanja, s tim što može ispoljiti aktivnost i prema NaOCl rezistentnim sojevima bakterija (*E. Faecalis*, *C. Albicans*). Antimikrobni mehanizam dejstva CHX vezan je za katjonsku strukturu njegovih molekula, zbog čega ovaj irigans ima jak afinitet prema negativno naelektrisanim fosfatnim grupama ćelijskog zida, povećavajući permeabilnost i mogućnost prodiranja sredstva u bakteriju⁹. Hlorheksidin na niskim koncentracijama (0,2%) ima bakteriostatski efekat. Više koncentracije (2%) su baktericidne i uslovljavaju gubitak ćelijskih elemenata, precipitaciju i koagulaciju citoplazme, a promene koje nastaju na ćelijskom zidu bakterije imaju ireverzibilan karakter^{9,10}.

Ovaj irigans postiže efikasnu dezinfekciju kanala korena zbog osobine supstantivnosti, tj. postepenog i prolongiranog dejstva na mikroorganizme^{10,11}. Međutim, za razliku od NaOCl, nije u stanju da rastvori organski materijal unutar kanala korena, što predstavlja jedan od glavnih nedostataka CHX^{1,9}.

S obzirom da i NaOCl i CHX imaju niz prednosti i mana, mnogi autori su preporučili

activity of NaOCl related to the amount of free chloride anions, reducing the concentration, can be compensated by increasing the volume. Therefore, for bacteria reduction in the canal system, the NaOCl quantity is more important than its concentration. Also, a rise in temperature and use of ultrasonic agitation increased the effectiveness of the solution^{1,2,8}.

Literature data indicate significantly lower in vivo antimicrobial NaOCl activity. It is assumed that the reason for this is inadequate surface tension, which restricts access to the lateral and apical ramifications, narrow and accessory canals that remain poorly or insufficiently treated. Additionally, the presence of organic matter (tissue remnants, inflammatory exudate, dentine collagen, microbial biomass) consumes NaOCl and weakens its effect¹.

Due to the toxicity of high concentrations of NaOCl solution, lack of access to all parts of the canal system, and the reduction of activity in vivo, it appears that there is no rationale for using hypochlorite solution, as an endodontic irrigant, at a concentration higher than 1%².

Chlorhexidine (CHX) at concentrations of 0.2-2% has a similar spectrum of activity, but the activity can be manifested against NaOCl-resistant strains of bacteria (*E. faecalis*, *C. albicans*). Antimicrobial mechanism of CHX action is related to cationic structure of its molecules, making the irrigant has a strong affinity for the cell wall of microorganisms, interacting with the negatively charged phosphate groups and increasing permeability and the possibility of penetration of irrigants into bacteria⁹. Chlorhexidine in low concentrations (0,2%) has a bacteriostatic effect. Higher concentrations have a bactericidal effect and influence on the loss of cellular elements, precipitation and coagulation of the cytoplasm, and the changes that occur in the cell wall of bacteria have an irreversible character^{9,10}.

This irrigants provides effective disinfection of the root canal due to characteristics of substantivity, ie. gradual and prolonged effects on microorganisms^{10,11}. However, unlike the sodium hypochlorite solution, it is not able to dissolve organic material within the root canal, and this is the main disadvantage of the CHX^{1,9}.

Given that NaOCl and CHX have a number of advantages and disadvantages, many authors have recommended that these two irrigants should be used together to enhance the

da se ova dva irigansa koriste zajedno u cilju poboljšanja antimikrobne aktivnosti u kanalu korena¹². Kuruvilla i Kamath (1998) su testirali naizmeničnu primenu 2,5% NaOCl i 0,2% CHX i ustanovili sinergizam antibakterijskog delovanja oba preparata i bolju razgradnju organskog tkiva nego kada se ovi irigansi koriste posebno¹³.

Etilen-diamin-tetraacetat (EDTA) uklanja neorganski deo dentinskog zida olakšavajući prolaz endodontskim instrumentima. Koristi se u koncentracijama od 15-20%. Ovo organsko jedinjenje sa metalnim katjonima (kalcijum, magnezijum) izdentinastvarahelatne komplekse i time demineralizuje dentin. Etilen-diamin-tetraacetat može da odvoji adheriran biofilm sa zidova kanala korena, što ga čini relativno uspešnim u redukciji mikroorganizama, uprkos njegovom ograničenom antiseptičnom kapacitetu^{1,2}. S obzirom da ne deluje na organski deo razmaznog sloja i ne poseduje antimikrobna svojstva, EDTA treba koristiti sa nekom proteolitičkom komponentom. Preporučeno vreme za uklanjanje razmaznog sloja pomoću EDTA je jedan minut. Duže izlaganje dovodi do erozije, sa značajnim uklanjanjem peritubularnog i intratubularnog dentina^{14,15}.

Limunska kiselina je slaba organska kiselina, koja u koncentraciji od 10% efikasno eliminiše razmazni sloj i neutrališe aktivnost anaerobnih bakterija uklanjajući bakterijske toksine sa zidova kanala korena¹⁶. In vitro studije su pokazale njenu citotoksičnost, ali u poređenju sa 17% EDTA, 10% limunska kiselina je značajno biokompatibilnija¹⁷.

Maleinska kiselina je nezasićena karbonska kiselina, koja se uglavnom koristi kao kondicioner u adhezivnoj stomatologiji. Nedavno su objavljeni podaci da se ova kiselina može koristiti kao endodontski irigans koji u koncentraciji od 7% značajno bolje uklanja razmazni sloj u apeksnoj trećini od 17% EDTA¹⁸. Takođe je ustanovljeno da 7% MA pokazuje manji citotoksični efekat u poređenju sa 17% EDTA¹⁹.

Interakcije između iriganasa

Ustanovljena je interakcija između dva najčešće korišćena irigansa u endodontskoj terapiji, NaOCl i CHX, koja se ogleda u prebojavanju dentina i stvaranju narandžastobraon precipitata.

antimicrobial activity of root canal¹². Kuruvilla and Kamath (1998) tested combination of 2.5% NaOCl and 0.2% CHX and found synergistic antibacterial activity and better decomposition of organic tissue than that of either agent used separately¹³.

Ethylene-diamine-tetra-acetate (EDTA) removes the inorganic part of the dentinal wall facilitating the passage of endodontic instruments. It is used in concentrations of 15-20%. This is an organic compound, and with the metal cations (calcium, magnesium) from dentin creates chelate complexes and thereby demineralised the dentin. Ethylene-diamine-tetra-acetate can separate adhered biofilm from the root canal walls, which makes it relatively successful in reducing microorganisms, despite its limited capacity antiseptic^{1,2}. Since there is no effect on the organic part of the smear layer and does not have antimicrobial properties, EDTA should be used with a proteolytic component. Recommended time to remove the smear layer with EDTA is one minute. Prolonged exposure leads to the erosion with significant removing of peritubular and intratubular dentin^{14,15}.

Citric acid (CA) is a weak organic acid, at a concentration of 10%, capable of eliminating the smear layer and neutralizing the activity of anaerobic bacteria removing bacterial toxins from the root canal walls¹⁶. In vitro studies have shown its cytotoxicity, but compared with 17% EDTA, 10% citric acid was significantly biocompatible¹⁷.

Maleic acid (MA) is unsaturated carboxylic acid used as an acid conditioner in adhesive dentistry. Recent study showed that 7% MA was significantly better than 17% EDTA in removing smear layer from the apical third of the root canal system¹⁸. Also, 7% MA was found to be less cytotoxic when compared with 17% EDTA¹⁹.

Interactions between irrigating solutions

Interaction between NaOCl and CHX: Interaction between the two most commonly used irrigant in endodontic therapy, NaOCl and CHX, which is reflected in the staining of the teeth and forming an orange-brown precipitate was established.

Basrani et al. (2007) have proven that there was a reaction immediately when mixed 2%

Basrani i sar. (2007) su dokazali da postoji trenutna reakcija, koja se ogleda u promeni boje rastvora kada se 2% CHX pomeša čak i sa vrlo niskim koncentracijama NaOCl (0,023%)²⁰. Povećanje koncentracije NaOCl na samo 0,19% dovodi i do formiranja vidljivog taloga čija se količina povećava sa koncentracijom NaOCl²⁰.

Slično tome i druga istraživanja su u cilju ispitivanja interakcije između ovih iriganasa koristila kombinaciju 2% CHX i različitih koncentracija NaOCl²¹⁻²⁵. Uočena je promena boje rastvora od svetlo do tamno braon, pri čemu je najtamniju prebojenost pokazao rastvor sa najvećom koncentracijom NaOCl. Prisustvo precipitata u zamućenom rastvoru zapaženo je tek nakon centrifugiranja. Ova studija je ukazala da interakcija između NaOCl i CHX, kao i stvaranje precipitata, ne zavise samo od koncentracije NaOCl, već i od koncentracije CHX²⁵.

Smatra se da precipitat nastaje kiselinsko-baznom reakcijom. Hlorheksidin ima kiselu reakciju (pH 5,5-6,0) i sposobnost da donira protone, dok je NaOCl baza i može da prihvati protone iz CHX^{9,20}. Rezultat ove razmene je formiranje nerastvorljivog taloga, koji prebojava dentin vezujući se za zidove pristupnog kaviteta i kanala korena^{26,27}. Na taj način, precipitat se ponaša kao rezidualni film i hemijski razmazni sloj koji sprečava difuziju intrakanalnih medikamenata u dentin, remeti adheziju materijala za punjenja kanala i kompromituje koronarnu restauraciju^{22,23,28,29}. Osim toga, ustanovljeno je da se ovaj talog sastoji od para-hloranilina (PCA), za koga je dokazano da deluje toksično u eksperimentima subkutane implantacije kod pacova³⁰. Literaturni podaci ukazuju ne samo na toksičnost PCA, nego i na toksičnost njegovih degradacionih produkata³¹⁻³³. Para-hloranilin se inače koristi kao pesticid i može imati kancerogeno dejstvo³⁴.

Interakcija između ova dva irigansa (NaOCl i EDTA) imaju potpuno različite karakteristike i svaki od njih ima svoj zadatak u dezinfekciji kanalnog sistema. Iz tog razloga je postojala ranija preporuka da se u protokolu dezinfekcije kanala korena koristi njihova mešavina. Međutim, interakcija između ovih iriganasa ipak postoji i ogleda se u naglom smanjenju količine slobodnog hlora odmah pri mešanju, što ima za posledicu gubitak aktivnosti NaOCl i nemogućnost rastvaranja mekog tkiva unutar kanala^{35,36}. Međutim, NaOCl nije u stanju da spreči demineralizujuće dejstvo EDTA na

CHX even with very low concentrations of sodium hypochlorite solution (0.023%)²⁰. Increasing NaOCl concentrations only to 0.19%, results in the staining solution and the formation of visible precipitate whose amount increased with the concentration of NaOCl solution²⁰.

There was an immediate reaction when 2% CHX was mixed with very low concentrations of NaOCl (0,023%), which resulted in changes of the solution color²¹⁻²⁵. There was the change in color from light to dark brown, so that the darkest discoloration of the solution showed the highest concentration of NaOCl. The presence of precipitates in the turbid solution was observed after centrifugation. This study indicated that the interaction between NaOCl and CHX, as well as the formation of precipitate, depends not only on the concentration of NaOCl, but also on the concentration of CHX²⁵.

It is believed that the precipitate is formed by the acid-base reaction. Chlorhexidine, a dicationic acid (pH 5.5 to 6.0), has the ability to donate protons, whilst NaOCl is alkaline and can accept protons from the dicationic acid^{9,20}. The result of this exchange is the formation of insoluble precipitate that can stain dentin, bonding to the walls of the access cavity and the root canal^{26,27}. In this way, a precipitate acts as a residual film and the chemical smear layer that may compromise the diffusion of intracanal medicaments into the dentine, disrupts the adhesion of the root canal filling and favours coronal restoration breakdown^{22,23,28,29}. In addition, it was found that the precipitate consists of the para-chloroaniline (PCA), which has been experimentally shown to have toxic effect in experiments of subcutaneous implantation in rats³⁰. Literature data indicate not only the toxicity of PCA, but also the toxicity of its degradation products³¹⁻³³. Para-chloroaniline is used as a pesticide and can have carcinogenic effect³⁴.

These two irrigant have completely different characteristics and each of them has its task in the root canal system disinfection. For this reason, there was a previous recommendation that there has been tempting to use them as a mixture. However, the interaction between these irrigant exists and is reflected in a sharp reduction in the amount of free chlorine immediately upon mixing, resulting in a loss of activity of NaOCl and inability of dissolution of soft tissue inside the canal^{35,36}. However, NaOCl was not able to prevent the effect of EDTA on peritubular

peritubularni i intertubularni dentin, jer dovodi do veoma spore degradacije ovog helatora. Zbog toga se ne preporučuje kao finalni irigans neposredno posle EDTA³⁷.

Hemijska reakcija između NaOCl i limunske kiseline ne stvara precipitat, već rezultira stvaranjem i „ispuštanjem“ mehurića iz novonastalog rastvora⁶. Podaci iz literature potvrđuju da sva helatna sredstva reaguju sa NaOCl, što ima za posledicu redukciju aktivnog jona hipohlorita i sledstveni pad aktivnosti NaOCl^{38,39}.

Pri mešanju EDTA i CHX dobija se nehomogeni rastvor sa mlečno belim precipitatom⁴⁰. Postoje dokazi da se ovaj precipitat ne sastoji od PCA, već ga čine soli koje nastaju neutralizacijom katjionskog CHX i anjonskog EDTA. Iako netoksičan sa hemijskog aspekta, ovaj talog može biti utisnut u periapeksni prostor ili predstavljati smetnju definitivnom punjenju⁴⁰. Mešanjem limunske kiseline i CHX ne dolazi do hemijske reakcije^{6,41}.

Ustanovljeno je da je maleinska kiselina manje toksična, a efikasnija u uklanjanju razmaznog sloja od EDTA^{18,19} i može biti korišćena kao zamena za EDTA, dok kombinacija MA i CHX nije pokazala formiranje precipitata i diskoloraciju^{38,39}.

Korekcija protokola irigacije

Prema podacima iz literature, za ispiranje, kao irigacioni tretman kanala korena, preporučuje se NaOCl, u cilju rastvaranja organskog sadržaja kanala, irigacija sa EDTA (limunska ili maleinska kiselina), u cilju eliminacije razmaznog sloja i završna irigacija sa CHX, u cilju povećanja antimikrobnog učinka i prolongiranja dezinficijentnog dejstva na zidove kanala korena^{2,9}.

Korišćenje CHX kao finalnog irigansa ima puno opravdanje zbog činjenice da se tada može najbolje iskoristiti: kanal korena je već očišćen od organskih ostataka i većine mikroorganizama (NaOCl) sa uklonjenim razmaznim slojem (helator) i mogućnošću da CHX u povoljnoj sredini ispolji osobinu supstantivnosti. Ovo je naročito značajno u slučajevima kada se endodontski tretman mora ponoviti i kada se očekuju gram pozitivne bakterije u kanalnom sistemu².

S obzirom da ni jedan irigans nije u stanju da sam ispuni sve potrebne zahteve, zbog čega

and intertubular dentin demineralisation, and it leads to a very slow degradation of the chelator. Therefore, it is not recommended as the final irrigant immediately after the EDTA³⁷.

The chemical reaction between the citric acid and NaOCl does not form a precipitate, and have resulted in the creation of „dropping“ of the newly-formed bubbles solution⁶. Literature data indicate that all chelating agents react with NaOCl, which results in a reduction of the active hypochlorite ion and subsequent decline in NaOCl activity^{38,39}.

During mixing EDTA and CHX, homogeneous solution with a milky-white precipitate is obtained⁴⁰. There is no evidence that this precipitate consists of PCA, but it consists of a salt formed by neutralization of the anionic EDTA and cationic CHX. Although non-toxic with chemical approaches, this residue can be embedded in the periapical area or impede obturation⁴⁰. Mixing citric acid and CHX does not give the chemical reaction^{6,41}.

It has been found that maleic acid is less toxic and more effective in the removal of the smear layer compared to the EDTA^{18,19}, and may be used as substitutes for EDTA, while a combination of CHX and MA does not form a precipitate and does not cause discoloration^{38,39}.

Correction of the irrigation protocol

According to the literature, the recommendation for root canal treatment before obturation is as follows: irrigation with NaOCl to dissolve the organic components, irrigation with EDTA in order to eliminate the smear layer and irrigation with CHX to increase the antimicrobial spectrum of activity and to impart substantivity^{2,9}.

The use of CHX as a final irrigant is fully justified since in this case can be best employed: root canal has been cleaned of organic residues and most of the microorganisms (NaOCl), with removed smear layer (helator) and the possibility that CHX in a favorable environment exhibits characteristic substantivity. This is particularly important in cases where endodontic treatment must be repeated when gram-positive bacteria in canal system are expected².

Since no single solution is able to fulfill these actions completely, therefore, their association is required, and the fact that they react in

je neophodna njihova kombinovana upotreba, i činjenice da oni pri kontaktu reaguju jedan sa drugim, jednostavne korekcije u protokolu irigacije kanala korena zuba mogu doprineti uspešnom okončanju endodontske terapije.

Da bi se sprečio nastanak precipitata i eventualno prebojavanje zuba, ne treba dozvoliti da NaOCl i CHX dođu u neposredan kontakt. Zaostali NaOCl posle ispiranja treba ukloniti destilovanom vodom i kanal korena osušiti papirnim poenima pre irigacije sa CHX^{5,22,23,27}. Neke laboratorijske studije su dokazale da alkohol i sirćetna kiselina mogu sprečiti stvaranje precipitata²¹. Do skora je i fiziološki rastvor bio predlagan kao pogodan među-irigans koji uspešno „razdvaja“ rastvore za ispiranje kanala korena zuba²⁷. Međutim, izgleda da između CHX i fiziološkog rastvora može postojati interakcija koja se ogleda u stvaranju rastvorljivog beličastog taloga⁶.

Natrijum hipohlorit i EDTA takođe treba koristiti odvojeno: obilna irigacija omogućava da NaOCl ispolji svoje antimikrobno dejstvo, a posle ispiranja destilovanom vodom^{5,35}, kao i sušenja kanala, moguće je upotrebiti EDTA za uklanjanje neorganskog debrisa³⁵.

Slično tome, može se predložiti ispiranje destilovanom vodom između EDTA i CHX, kao i sušenje kanala pre uvođenja CHX kao završnog irigansa⁵.

Zaključak

Interakcije između iriganasa u endodonciji i dalje su aktuelna tema i predstavljaju pravi izazov za istraživače. Još uvek je nedovoljno ispitan sastav i priroda produkata interakcije, kao i posledice koje bi ovaj toksičan supstrat mogao imati. Iako postoje preporuke koje uslovno mogu sprečiti stvaranje precipitata, dalja ispitivanja su neophodna da bi se ustanovio klinički prihvatljiv način njegovog uklanjanja u situacijama kada se on ipak formira. S tim u vezi, protokol irigacije podleže novom konceptu, u cilju prevencije antagonističkih reakcija i osim efikasne, omogućavanja bezbedne irigacije kanalnog sistema zuba.

contact with each other, simple adjustments in the protocol of root canal irrigation can prevent the occurrence of adverse reactions between endodontic irrigants.

In order to prevent the formation of precipitates and possible tooth discoloration, the direct contact of NaOCl and CHX should be avoided. Residual NaOCl should be removed after rinsing with distilled water or saline solution and the root canal should be dried with paper points before irrigation with CHX^{5,22,23,27}. Some laboratory studies have shown that alcohol and acetic acid can prevent the formation of precipitate²¹. Until recently, the saline solution was proposed as a suitable „inter-irrigant“ which successfully „separates“ irrigation solutions²⁷. However, it seems that between the CHX and saline may be interaction, which is reflected in the creation of soluble whitish precipitate⁶.

NaOCl and EDTA should also be used separately: abundant irrigation allows NaOCl to demonstrate its antimicrobial activity, and after irrigation with distilled water^{5,35} and the root canal drying, EDTA should be used to remove inorganic debris³⁵.

Separate use of EDTA and CHX is also recommended. It is suggested to rinse the root canal with saline solution or distilled water after the use of EDTA, as well as to dry root canal before the introduction of CHX as a final irrigant⁵.

Conclusion

Interactions between irrigants in endodontics are interesting topic and a challenge for researchers. The nature and composition of precipitates are still not well understood, as well as the consequences that this toxic substrate could have. Although there are recommendations for conditional prevention of precipitate formation, further investigations are necessary to determine the clinically acceptable way to resolve them in situations where they have already been formed. In this regard, the protocol is subjected to the new concept of irrigation in order to prevent antagonistic reactions and provides, besides efficient, safe root canal irrigation.

LITERATURA / REFERENCES

1. Haapasalo M, Shen Y, Qian W, Gao Y. Irrigation in endodontics. *Dent Clin North Am* 2010;54:291-312.
2. Zehnder M. Root canal irrigants. *J Endod* 2006; 32:389-98.
3. Basrani B. Irrigation in endodontic treatment. *Alpha Omegan* 2011;104:18-25.
4. Kandaswamy D, Venkateshbabu N. Root canal irrigants. *J Conserv Dent* 2010;13:256-264.
5. Rossi-Fedele G, Dogramaci EJ, Guastalli AR, Steier L, de Figueiredo JA. Antagonistic interactions between sodium hypochlorite, chlorhexidine, EDTA, and citric acid. *J Endod* 2012; 38:426-31.
6. Prado M, Santos Junior HM, Rezende CM, et al. Interactions between irrigants commonly used in endodontic practice: a chemical analysis. *J Endod.* 2013, 39:505-510.
7. Estrela C, Estrela CRA, Barbin EL, Spano JCE, Marchesan MA, Pecora JD. Mechanism of action of sodium hypochlorite. *Braz Dent J* 2002; 13:113-117.
8. Stojicic S, Zivkovic S, Qian W, Zhang H, Haapasalo M. Tissue dissolution by sodium hypochlorite: effect of concentration, temperature, agitation, and surfactant. *J Endod*; 2010; 36:1558-62.
9. Mohammadi Z, Abbott PV. The properties and applications of chlorhexidine in endodontics. *Int Endod J* 2009; 42:288-302.
10. Mohammadi Z, Abbott PV. Antimicrobial substantivity of root canal irrigants and medicaments: a review. *Aust Endod J* 2009; 35:131-39.
11. Rosenthal S, Spangberg L, Safavi K. Chlorhexidine substantivity in root canal dentin. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2004; 98:488-492.
12. Kishen A, Sum CP, Mathew S, Lim CT. Influence of irrigation regimens on the adherence of *Enterococcus faecalis* to root canal dentin. *J Endod* 2008;34:850-54.
13. Kuruvilla JP, Kamath P. Antimicrobial activity of 2.5% sodium hypochlorite and 0.2% chlorhexidine gluconate separately and combined, as endodontic irrigants. *J Endod* 1998; 24:472-76.
14. Calt S, Serper A. Time-dependent effects of EDTA on dentin structures. *J Endod* 2002; 28:17-9.
15. Gašić J, Dačić-Simonović D, Radičević G, Mitić A, Stojilković G, Daković J. Skening electron mikrofotografski izgled zidova kanala korena posle uklanjanja razmaznog sloja. *Stom Glas S* 2003;2:65-9.
16. Herrera DR, Santos ZT, Tay LY, Silva EJ, Loguercio AD, Gomes BP. Efficacy of different final irrigant activation protocols on smear layer removal by EDTA and citric acid. *Microsc Res Tech* 2013;76:364-69.
17. Malheiros CF, Marques MM, Gavini G. In vitro evaluation of the cytotoxic effects of acid solutions used as canal irrigants. *J Endod* 2005;31:746-48.
18. Ballal NV, Kandian S, Mala K, Bhat KS, Acharya S. Comparison of the efficacy of maleic acid and ethylenediaminetetraacetic acid in smear layer removal from instrumented human root canal: a scanning electron microscopic study. *J Endod* 2009;35:1573-76.
19. Ballal NV, Kundabala M, Bhat S, Rao N, Rao BS. A comparative in vitro evaluation of cytotoxic effects of EDTA and maleic acid: root canal irrigants. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009;108:633-38.
20. Basrani BR, Manek S, Sodhi RNS, Fillery E, Manzur A. Interaction between sodium hypochlorite and chlorhexidine gluconate. *J Endod* 2007; 33:966-69.
21. Marchesan MA, Pasternak BJr, Afonso MMF, Souza-Neto MD, Paschoalato C. Chemical analysis of the flocculate formed by the association of sodium hypochlorite and chlorhexidine. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007; 103:103-5.
22. Bui TB, Baumgartner JC, Mitchell JC. Evaluation of the interaction between sodium hypochlorite and chlorhexidine gluconate and its effect on root dentin. *J Endod* 2008; 34: 181-5.
23. Akisue E, Tomita VS, Gavini G, Poli de Figueiredo JA. Effect of the combination of sodium hypochlorite and chlorhexidine on dentinal permeability and scanning electron microscopy precipitate observation. *J Endod* 2010;36:847-50.
24. Basrani BR, Manek S, Matbers D, Fillery E, Sodhi RNS A. Determination of 4-chloraniline and its derivatives formed in the interaction sodium hypochlorite and chlorhexidine by using gas chromatography. *J Endod* 2010;36:312-14.
25. Gasic J, Popovic J, Zivkovic S, Petrovic A, Barac R, Nikolić M. Ultrastructural analysis of the root canal walls after simultaneous irrigation of different sodium hypochlorite concentration and 0.2% chlorhexidine gluconate. *Microsc Res Tech* 2012;75:1099-103.
26. Vivacqua-Gomes N, Ferraz CC, Gomes BP, Zaia AA, Teixeira FB, Souza-Filho FJ. Influence of irrigants on the coronal microleakage of laterally condensed gutta-percha root fillings. *Int Endod J* 2002; 35:791-95.
27. Krisnamurtby S, Sudbakaran S. Evaluation and prevention of the precipitate formed on interaction between sodium hypochlorite and chlorhexidine. *J Endod* 2010;36:1154-57.
28. Stratton R, Apicelle M, Mines P. A fluid filtration comparison of gutta-percha versus Resilon, a new soft resin endodontic obturation system. *J Endod* 2006;32(7):642-45.
29. Prado M, Simao RA, Gomes BP. Evaluation of different irrigation protocols concerning the formation of chemical smear layer. *Microsc Res Tech* 2013;76(2):196-200.

30. Cintra LT, Watanabe S, Samuel RO, et al. The use of NaOCl in combination with CHX produces cytotoxic product. *Clin Oral Investig* 2013; DOI 10.1007/s00784-013-1049-5.
31. Matsumoto M, Aiso S, Senoh H, et al. Carcinogenicity and chronic toxicity of parachloronitrobenzene in rats and mice by two-year feeding. *J Environ Pathol Toxicol Oncol* 2006; 25: 571–84.
32. Thomas JE, Sem DS. An in vitro spectroscopic analysis to determine whether para-chloroaniline is produced from mixing sodium hypochlorite and chlorhexidine. *J Endod* 2010;36:315-17.
33. Nowicki JB, Sem DS. An in vitro spectroscopic analysis to determine the chemical composition of the precipitate formed by mixing sodium hypochlorite and chlorhexidine. *J Endod* 2011;37:983-88.
34. Chhabra RS, Huff JE, Haseman JK, Elwell MR, Peters AC. Carcinogenicity of p-chloroaniline in rats and mice. *Food Chem Toxicol* 1991;29:119–24.
35. Grawehr M, Sener B, Waltimo T, Zehnder M. Interactions of ethylenediamine tetraacetic acid with sodium hypochlorite in aqueous solutions. *Int Endod J* 2003;36:411–15.
36. Clarkson RM, Podlich HM, Moule AJ. Influence of ethylenediaminetetraacetic acid on the active chlorine content of sodium hypochlorite solutions when mixed in various proportions. *J Endod* 2011;37:538-43.
37. Grande NM, Plotino G, Falanga A, et al. Interaction between EDTA and sodium hypochlorite: a nuclear magnetic resonance analysis. *J Endod* 2006;32:460–64.
38. Ahmed HM, Abbott PV. Discolouration potential of endodontic procedures and materials: a review. *Int Endod J* 2012;45:883-97.
39. Ballal NV, Moorkoth S, Mala K, Bhat KS, Husen SS, Pathak S. Evaluation of chemical interactions of maleic acid with sodium hypochlorite and chlorhexidine gluconate. *J Endod* 2011; 37:1402-05.
40. Rasimick BJ, Nekich M, Hladek M, Musikant BL, Deutsch AS. Interaction between chlorhexidine digluconate and EDTA. *J Endod* 2008;34:1521–23.
41. Gonzalez LS, Camejo AD, Sanchez SP, Bolanos-CV. Effect of CHX on the decalcifying effect of 10% citric acid, 20% citric acid, or 17% EDTA. *J Endod* 2006; 32:781–4.

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ORALNA HIGIJENA KAO DOMINANTNA DETERMINANTA ZDRAVLJA

ORAL HYGIENE AS THE DOMINANT DETERMINANT OF HEALTH

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Sažetak

Uvod/Cilj Naučni i zdravstveni temelji u prevenciji karijesa zasnivaju se na stavu da je prepoznavanje karijesa na nivou kavitacije prekasno da bi se zadovoljila savremena načela struke. Međutim, kod nas još ne postoji dovoljno razvijena svijest o važnosti oralnog zdravlja za cjelokupno zdravlje pojedinca, a još manje o važnosti sprovođenja oralne higijene.

Materijal i metod Istraživanje je sprovedeno po tipu studije presjeka, od maja do septembra 2009. godine u stomatološkim ordinacijama Doma zdravlja Tivat. Istraživanje su radili stomatološki timovi sa pacijentima starosti do petanaest godina. Instrument istraživanja bio je upitnik i stomatološki pregled usta i zuba. Pregled je izvršen prema metodologiji i kriterijima SZO. Odgovori dobijeni tokom intervjua upoređivani su sa podacima kliničkog pregleda.

Rezultati Analizirajući dobijene odgovore ustanovljeno je da najviše ispitanika pere zube dva puta dnevno, a stomatologa najčešće posjećuju jednom u šest mjeseci. Istraživanje je pokazalo da je kod 57% ispitanika pregledom uočeno postojanje karioznih mliječnih zuba. Kod više od 63% ispitanika nađeni su stalni kariozni zubi. Kod 14% ispitanika nađen je gingivitis, a kod 44,7% ispitanika uočena je ortodontska anomalija. Polovina ispitanika koja rijetko pere zube ima problema sa gingivitisom. Postoji statistički visoko značajna razlika u pojavi gingivitisa u vezi sa učestalošću pranja zuba.

Zaključak Postoji značajna razlika u održavanju higijene usta i zuba prema polu, kao i prema nekim drugim socio-demografskim karakteristikama ispitanika. Studija je pokazala povezanost karijesa i gingivitisa sa učestalošću pranja zuba i frekvencije posjeta stomatologu.

Ključne riječi: oralna higijena, preventivna stomatološka zaštita, prevencija karijesa, oralno zdravlje, kontrola plaka, pranje zuba, zdravstveno vaspitanje

Abstract

Background: Scientific and health foundations in caries prevention are based on the view that in order to meet modern principles that already exist within the profession it is too late if the caries is detected in the cavitation stage. However, there is not enough awareness of the importance of oral health to the overall health of an individual and even less about the importance of practicing oral hygiene.

Material and Methods: The research was carried out as a cross-sectional study from May to September 2009 in dentist offices at the Medical Center Tivat. It was conducted with patients under the age of 15 by dental teams. The research instruments were the questionnaire and dental examination of the mouth and teeth. The examination was done in accordance with the WHO methodology and criteria. The answers obtained from the questionnaire were correlated with the clinical data. Results: The obtained results showed that the most respondents brushed their teeth twice a day and that they usually visited a dentist once in six months. Clinical data also showed that 57% of respondents had carious deciduous teeth, more than 63% of respondents had carious permanent teeth, 14% had gingivitis and 44.7% of them had orthodontic anomalies. Half of the respondents who rarely brushed their teeth suffered from gingivitis. There was a high statistically significant difference between the occurrence of gingivitis and the frequency of tooth brushing.

Conclusion: There is a significant difference in the maintenance of oral hygiene according to gender as well as other socio-demographic characteristics of respondents. The study showed that there was a correlation between the occurrence of caries and gingivitis and the frequency of tooth brushing and visits to a dentist.

Key words: oral hygiene, preventive dental care, prevention of caries, oral health, plaque control, tooth brushing, health education

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Uvod

Naučni i zdravstveni temelji u prevenciji karijesa zasnivaju se na stavu da je prepoznavanje karijesa na nivou kavitacije prekasno da bi se zadovoljila savremena načela struke. Sprovedenje mjera i aktivnosti prije pojave kavitacije bazični su principi moderne preventivne terapije karijesa, kako bi se osigurala pravilna i adekvatna prevencija bolesti i iskoristile sve mogućnosti modernih preventivnih zahvata¹. Međutim, kod nas još ne postoji dovoljno razvijena svijest o važnosti oralnog zdravlja za cjelokupno zdravlje pojedinca, a još manje o važnosti sprovođenja oralne higijene². Edukacija roditelja i djece o pravilnom održavanju oralne higijene trebalo bi da bude osnova masovne prevencije karijesa. Tako se, prvenstveno kroz vrtić, školu i pedijatrijske ambulante, roditeljima, ali i djetetu, daju osnovne informacije i smjernice za očuvanje zdravlja zuba i važnost odlaska stomatologu na kontrolne preglede. Školsko doba je vrijeme kada se trajno stiču navike i kada je zdravstveno-vaspitna informacija pravovremeno pružena. Zdravstveno vaspitanje je mjera preventivne zaštite kojom se, razvijanjem zdravog i mijenjanjem štetnog zdravstvenog ponašanja, te poučavanjem i širenjem informacija o zdravstvenim postupcima, postiže unaprjeđenje zdravlja, sprječavanje, liječenje i ublažavanje posljedica bolesti³.

Glavni etiološki činitelj za nastanak karijesa i bolesti parodontata je zubni plak. Mikrobiološki, dentalni plak, koji predstavlja nemineralizovanu organizovanu nakupinu mikroorganizama u organskom matriksu mukopolisaharida, odnosno naslage na zubima, primarni je uzrok gingivitisa⁴. Higijena usta važan je činitelj u borbi protiv dentalnog karijesa, posebno kod urbanog i civilizovanog čovjeka, zbog konzumiranja rafinirane hrane. Uočeno je da se dentalno-bakterijski plak mnogo brže formira kod djece nego kod odraslih. Stepenn oralne higijene mijenja mikrobnu akumulaciju na zubnim pločama, a kontrola naslaga temelj je prevencije karijesa i parodontalnih bolesti. Kod epidemioloških oralnih istraživanja važno je utvrditi stepenn oralne higijene i stepenn upalnih promjena gingive. Stepenn oralne higijene utvrđujemo pomoću OHI-indeksa¹.

Stomatološko-zdravstveno vaspitanje trebalo bi da bude dio opšteg vaspitanja. Suštinski cilj

Introduction

Scientific and health foundations in caries prevention are based on the view that in order to meet modern principles that already exist within the profession it is too late if the caries is detected in the cavitation stage. Measures and activities that are implemented prior to the onset of cavitation are basic principles of modern preventive treatment of caries in order to ensure proper and adequate disease prevention and to use all features of modern preventive treatment¹. However, there is not enough awareness of the importance of oral health to overall health of an individual and even less about the importance of practicing oral hygiene. Health education of parents and children about proper oral hygiene should be the basis of extensive prevention of caries. Basic information and guidelines regarding oral health protection and the importance of dental check-ups are given not only to parents but also to their children primarily through pre-school institutions, schools and pediatric clinics. School age is the period when long-lasting habits are acquired and information regarding health education is timely provided. Health education is a measure of preventive care which through development of proper health behavior and changes of harmful health behavior, education and dissemination of information regarding medical treatment can achieve health improvement, prevention and also treatment and mitigation of diseases².

The main etiological factor for caries and periodontal disease is dental plaque. Microbial dental plaque, which is non-mineralized layers of microorganisms in organic matrix of polysaccharides i.e. deposits on teeth, is the primary cause of gingivitis⁴. Oral hygiene is an important factor in the fight against dental caries especially in urban population due to consumption of refined food. It is known that microbial dental plaque accumulates faster in children than in adults. The level of oral hygiene changes microbial accumulation on dental plates and the plaque control is the basis for prevention of dental caries and periodontal diseases. In epidemiologic oral research it is important to determine the level of oral hygiene and degree of inflammatory changes of the gingiva. The level of oral hygiene is determined by OHI-index¹.

Dental health education should be a part of the general health education. The key objective

sprovedenja zdravstveno-vaspitnih programa je smanjenje incidencije, u prvom redu karijesa i parodontalnih bolesti, ali i ostalih bolesti usne duplje⁵. Osim toga, vrlo je bitno obezbijediti preventivne stomatološke preglede, čime se ističe značaj prevencije oboljenja usta i zuba. Suštinska preporuka je da je preventiva najisplativiji oblik zaštite oralnog zdravlja⁶.

Cilj

Osnovni ciljevi istraživanja su procjena oralno-higijenske navike među učenicima osnovne škole, kao i uticaj postojećeg ponašanja u oblasti higijene usta i zuba na evidentirane poremećaje zdravlja usta i zuba.

Metod rada

Istraživanje je sprovedeno po tipu studije presjeka, od maja do septembra 2009. godine u stomatološkim ordinacijama Doma zdravlja Tivat. Istraživanje su radili stomatološki timovi sa pacijentima starosti od 11 do 15 godina, a koji u reformisanom sistemu zdravstva Crne Gore imaju prava na besplatnu stomatološku zdravstvenu zaštitu.

Instrument istraživanja bio je upitnik. Pitanja u upitniku odnosila su se na navike održavanja higijene usta i zuba. Upitnik se sastojao od ukupno 16 pitanja, od kojih su 15 bila pitanja zatvorenog tipa, a koja su se odnosila na navike u oblasti oralne higijene, kao i na navike kontrole kod stomatologa. Ovaj dio upitnika ispunjavala je medicinska sestra, koja radi sa stomatologom u ordinaciji, gdje je ispitanik zadovoljavao svoju potrebu iz oblasti oralnog zdravlja, nakon odgovora na postavljeno pitanje. Poslednje, 16. pitanje, koje je, takođe, ispunjavala ista medicinska sestra prema nalogu stomatologa, odnosilo se na objektivni nalaz oralnog zdravlja. Ovaj nalaz se odnosio na utvrđeno stanje oralnog zdravlja i obuhvatao ukupan broj prisutnih zuba na pregledu i to posebno mliječnih i stalnih, zatim ukupan broj karijesnih zuba i to posebno mliječnih i stalnih, prisustvo gingivitisa i prisustvo ortodontskih anomalija.

Pored toga, kao instrument istraživanja poslužio je stomatološki pregled usta i zuba za dobijanje podataka o oralnom zdravlju ispiti-

of the implementation of health education programs is to reduce primarily the incidence of caries and periodontal diseases, but also other oral cavity diseases⁵. In addition, it is essential to provide preventive dental check-ups so that the importance of oral disease prevention could be emphasized. The key recommendation is that prevention is the most cost-effective form of oral health care⁶.

Aim

The main objectives of this study were assessment of oral hygiene habits among primary school children as well as the impact of current behavior in the field of oral hygiene on identified oral health disorders.

Materials and methods

The research was carried out as a cross-sectional study from May to September 2009 in dentist offices at the Medical Center Tivat. It was conducted with patients under the age of 15 who were provided with free dental care in the reformed health care system in Montenegro by dental teams.

The research instrument was a questionnaire. The questions included in the questionnaire were related to the oral hygiene habits. The questionnaire consisted of 16 questions of which 15 were closed questions about oral hygiene habits and dental check-ups. This section of the questionnaire was filled in, after the respondents gave their answers, by the nurse who worked in the dental office where the oral health services were provided to respondents. The last question number 16 was also filled in by the nurse according to dentist examination that is an objective finding of oral health. These findings determined the condition of oral health and they included the total number of present teeth during examination, both deciduous and permanent teeth, total number of carious teeth, both deciduous and permanent ones and presence of gingivitis and orthodontic anomalies.

In addition, dental examination was used as a research instrument in order to obtain information on the condition of oral health in examined children. The examination was done in accordance with WHO methodology and criteria

vane djece. Pregled je izvršen prema metodologiji i kriterijima SZO-a, služeći se stomatološkim ogledalima, standardnim parodontnim sondama CPITN i osvjetljenjem prigodnim za ovu vrstu pregleda. Parametri korišteni za procjenu statusa oralnog zdravlja bili su indeksi: DMFT i SiC, mjesni parodontni indeks i indeks razvojnih defekata u caklini (RDC).

Odgovori dobijeni tokom intervjua upoređivani su sa podacima dobijenim ispitivanjem zdravlja usta i zuba po protokolu dobre medicinske prakse za ove vrste pregleda.

Za statističku obradu korišćene su metode deskriptivne statistike i statističke metode za ispitivanje značajnosti razlika putem Hi-kvadrat testa za kategorijska obilježja i jednofaktorska analiza varijanse (ANOVA) za ispitivanje uticaja pojedinih faktora na objektivno stanje zdravlja zuba kod djece.

Rezultati

Istraživanjem su obuhvaćeni svi ispitanici koji su tokom tri mjeseca ljeta 2009. godine posjetili stomatološku ordinaciju Doma zdravlja Tivat. Analiza strukture ispitanika po polu pokazuje da je pola ispitanika bilo muškog, dok je druga polovina bila ženskog pola. Starost ispitanika iznosila je od 11 do 15 godina.

Istraživanje je pokazalo da postoji visoko statistički značajna razlika među ispitanicima u učestalosti pranja zuba, zavisno od njihovog materijalnog stanja (X^2 test = 23,132, $p < 0,001$). Među ispitanicima koji rijetko peru zube, prema ukupnoj zastupljenosti, najbrojniji su oni koji su svoje materijalno stanje ocijenili kao loše (40%), a zatim slijede oni koji svoje materijalno dobro procjenjuju kao osrednje. Često peru zube, najviše, ispitanici koji imaju dobro materijalno stanje (Tabela 1).

Frekvencija pranja zuba kod ispitanika značajno je različita zavisno od školske spremne majke (X^2 test = 18,664; $p < 0,05$). Dva i više puta dnevno zube peru najčešće ispitanici koji su naveli da su njihove majke završile visoku školu. Ispitanici čije su majke završile samo osnovnu školu ili rijetko ili jednom dnevno peru zube (Tabela 2).

Na tabeli 3 se može uočiti da se gingivitis javlja najčešće kod ispitanika koji su naveli da rijetko peru zube ($X^2 = 20,44$, $p < 0,05$). Polovina ispitanika koja rijetko pere zube ima problema sa gingivitisom. Gotovo jedan od deset ispitanika koji su naveli da samo jednom tokom dana peru zube ima probleme sa gingivitisom (Tabela 3).

by using dental mirror, standard CPITN periodontal probe and lighting appropriate for this type of examination.

The parameters used to assess the condition of oral health were indices: DMFT I SiC, community periodontal index and index of developmental defects of enamel (DDE).

The answers obtained from the questionnaire were correlated with the data obtained by examination of oral health according to protocol of good medical practice for this type of examination.

Methods of descriptive statistics and statistical methods for determining significance of difference, using the chi-square test for categorical characteristics, and one factor analysis of variance (ANOVA) for determining impact of individual factors on the objective condition of oral health in children, were used for statistical data analysis.

Results

The study included all patients who visited dental offices at the Medical center Tivat during three summer months in 2009. Analysis of respondents according to gender showed that half of the respondents were male i.e. female. The age of respondents ranged from 11 to 15 years.

The research showed that there was a highly significant statistical difference among respondents in frequency of tooth brushing in relation to their financial position (X^2 test = 23.132, $p < 0.001$). Among respondents who rarely brushed their teeth, most numerous were those who assessed their financial situation as bad (40%), followed by those who assessed their financial situation as satisfactory. Respondents who had good financial position most frequently brushed their teeth (Table 1).

Frequency of tooth brushing was significantly different with regard to the respondents' mother's education level (X^2 test = 18,664, $p < 0,05$). Respondents whose mothers had higher education most frequently brushed their teeth twice a day or more often than that. Respondents whose mothers had completed only primary school either rarely or once a day brushed their teeth (Table 2).

From Table 3 it can be concluded that gingivitis occurs most frequently in respondents who rarely brushed their teeth ($X^2 = 20,44$, $p < 0,05$). Half of the respondents who rarely brushed their teeth had problems with gingivitis. Almost one in ten respondents who brushed their teeth only once a day had problems with gingivitis (Table 3).

Tabela 1. Odnos frekvencije pranja zuba i materijalnog stanja ispitanika
Table 1. Relationship between frequency of tooth brushing and financial position of respondents

OCJENA MATERIJALNOG STATUSA / ASSESSMENT OF FINANCIAL POSITION	UČESTALOST PRANJA ZUBA / FREQUENCY OF TOOTH BRUSHING				UKUPNO TOTAL
	Rijetko / Rarely	Jednom dnevno / Once a day	Dva puta dnevno / Twice a day	Tri puta dnevno / Three times a day	
DOBRO / GOOD Broj / Number %	0 0,0%	1 11,1%	4 44,4%	4 44,4%	6 100,0%
OSREDNJE / SATISFACTORY Broj / Number %	18 13,2%	31 22,8%	80 58,8%	7 5,1%	136 100,0%
LOŠE / BAD Broj / Number %	2 40,0%	1 20,0%	2 40,0%	0 0,0%	5 100,0%
UKUPNO / TOTAL Broj / Number %	20 13,3%	33 22,0%	86 57,3%	11 7,3%	147 100,0%

Tabela 2. Odnos frekvencije pranja zuba i školske spremlje majke
Table 2. Relationship between frequency of tooth brushing and mother's education level

STEPEN OBRAZOVANJA MAJKE / MOTHER'S EDUCATION LEVEL	UČESTALOST PRANJA ZUBA / FREQUENCY OF TOOTH BRUSHING				UKUPNO TOTAL
	Rijetko / Rarely	Jednom dnevno / Once a day	Dva puta dnevno / Twice a day	Tri puta dnevno / Three times a day	
OSNOVNA ŠKOLA / ELEMENTARY SCHOOL Broj / Number %	1 50,0%	1 50,0%	0 0,0%	0 0,0%	2 100,0%
SREDNJA ŠKOLA / SECONDARY SCHOOL Broj / Number %	18 13,2%	31 22,8%	79 58,8%	7 5,1%	135 100,0%
VISOKA ŠKOLA / HIGHER EDUCATION Broj / Number %	0 0,0%	1 8,3%	7 58,3%	4 33,3%	12 100,0%
UKUPNO TOTAL Broj / Number %	19 12,8%	33 22,1%	86 57,7%	11 7,4%	149 100,0%

Tabela 3. Učestalost pojave gingivitisa kod ispitanika u odnosu na frekvenciju pranja zuba
Table 3. Frequency of occurrence of gingivitis in respondents with regard to frequency of tooth brushing

UČESTALOST PRANJA ZUBA / FREQUENCY OF TOOTH BRUSHING	Prisutan gingivitis / Occurrence of gingivitis		UKUPNO TOTAL	
	da / yes	ne / no		
	broj / number	10	10	20
RIJETKO / RARELY	% učestalost pranja zuba / % frequency of tooth brushing	50.0%	50.0%	100.0%
	% prisutan gingivitis / % occurrence of gingivitis	47.6%	7.8%	13.3%
	broj / number	3	30	33
JEDNOM DNEVNO / ONCE A DAY	% učestalost pranja zuba / % frequency of tooth brushing	9.1%	90.9%	100.0%
	% prisutan gingivitis / % occurrence of gingivitis	14.3%	23.3%	22.0%
	broj / number	7	79	86
DVA PUTA DNEVNO / TWICE A DAY	% učestalost pranja zuba / % frequency of tooth brushing	8.1%	91.9%	100.0%
	% prisutan gingivitis / % occurrence of gingivitis	33.3%	61.2%	57.3%
	broj / number	1	10	11
TRI PUTA DNEVNO / THREE TIMES A DAY	% učestalost pranja zuba / % frequency of tooth brushing	9.1%	90.9%	100.0%
	% prisutan gingivitis / % occurrence of gingivitis	4.8%	7.8%	7.3%

Učestalost posjeta stomatologu statistički značajno je povezana sa pojavom gingivitisa ($X^2 = 24,5$, $p < 0.05$). Najređe se gingivitis javlja kod ispitanika koji stomatologa posjećuju kada god je potrebno, odnosno kada god primjete ili osjete neke promjene. Više od polovine ispitanika koji se stomatologu javljaju samo kada ih zaboli zub imaju probleme sa gingivitisom (Tabela 4).

The frequency of visits to dentist is statistically significantly correlated with development of gingivitis. Gingivitis the least frequently occurred in patients who visited dentist whenever it was necessary, that is when they noticed or felt any change. More than a half of respondents visited dentist only when they had toothache or had problems with gingivitis (Table 4).

Tabela 4. Povezanost posjeta stomatologu i pojava gingivitisa
Table 4. Relationship between visits to a dentist and occurrence of gingivitis

UČESTALOST POSJETA STOMATOLOGA / FREQUENCY OF VISITS TO A DENTIST		Prisutan gingivit / Occurrence of gingivitis		UKUPNO TOTAL
		da / yes	ne / no	
RIJETKO / RARELY	broj / number	2	49	51
	% učestalost posjete stomatologu / % frequency of visits to a dentist	3,9%	96,1%	100,0%
	% prisutan gingivit / % occurrence of gingivitis	10,5%	40,8%	36,7%
NA TRI MJESECA / EVERY THREE MONTHS	broj / number	4	44	48
	% učestalost posjete stomatologu / % frequency of visits to a dentist	8,3%	91,7%	100,0%
	% prisutan gingivit / % occurrence of gingivitis	21,1%	36,7%	34,5%
NA ŠEST MJESECI / EVERY SIX MONTHS	broj / number	6	12	18
	% učestalost posjete stomatologu / % frequency of visits to a dentist	33,3%	66,7%	100,0%
	% prisutan gingivit / % occurrence of gingivitis	31,6%	10,0%	12,9%
KADA GOD TREBA / WHEN IT IS NEEDED	broj / number	2	11	13
	% učestalost posjete stomatologu / % frequency of visits to a dentist	15,4%	84,6%	100,0%
	% prisutan gingivit / % occurrence of gingivitis	10,5%	9,2%	9,4%
KADA ZABOLI ZUB/ TOOTHACHE	broj / number	5	4	9
	% učestalost posjete stomatologu / % frequency of visits to a dentist	55,6%	44,4%	100,0%
	% prisutan gingivit / % occurrence of gingivitis	25,3%	3,3%	6,5%
UKUPNO / TOTAL	broj / number	19	120	139
	% učestalost posjete stomatologu / % frequency of visits to a dentist	13,7%	86,3%	100,0%
	% prisutan gingivit / % occurrence of gingivitis	100,0%	100,0%	100,0%

Diskusija

Istraživanje je pokazalo da postoji značajna povezanost materijalne situacije u porodicama ispitivane djece i obrazovanja njihovih majki sa frekvencijom pranja zuba, kao i sa urednošću posjećivanja stomatologa. Posjete stomatologu i frekvencija pranja zuba značajno su povezane

Discussion

The research showed that there was a significant correlation between financial position of respondents' family and their mother's education level and the frequency of tooth brushing and visits to a dentist. Visits to a dentist and frequency of tooth brushing were significantly

sa oboljenjima usta i zuba ispitanika, procjenjeno na osnovu relevantnih pokazatelja zdravlja.

Veliki broj istraživanja potvrđuje da postoji razlika u stavu djece u vezi sa redovnom kontrolom zdravlja usta i zuba, što je u odnosu sa socijalno-obrazovnom strukturom njihovih porodica. Iako se s oralnom higijenom djeca vrlo rano susreću i roditelji sve više svjesni važnosti oralnog zdravlja za cjelokupnu dobrobit svoje djece, uloga roditelja i djece u održavanju zdravlja usne šupljine često nije dovoljna, pa je nužno potražiti pomoć stomatologa. Kako bi se izbjegli ozbiljniji kvarovi i teže posljedice, stomatologa je najbolje posjećivati preventivno, čak i onda kada je sa zubima sve u redu⁷.

Ponašanje djece direktno je povezano sa procesom socijalizacije, koja se ostavlja, primarno, u sopstvenoj kući. Stoga je neophodno adekvatne mjere u cilju modifikacije ponašanja⁸ sprovesti od strane roditelja. Podaci pokazuju da postoji razlika u stavu djece u vezi sa redovnom kontrolom zdravlja usta i zuba, što je u odnosu sa socijalno-obrazovnom strukturom njihovih roditelja⁹. Stav da se redovitom preventivnom kontrolom mogu spriječiti oralna oboljenja očigledno nije prisutan kao životna praksa u porodicama iz kojih dolaze ispitivana djeca. U cilju izbjegavanja posljedica, stomatologa je najbolje posjećivati preventivno, čak i onda kada je sa zubima sve u redu.

Determinate koje su prepoznate kao značajni prediktori oboljenja usta i zuba od strane najvećeg broja autora bile su sljedeće: visina prihoda porodice, nivo obrazovanja, dodatno uzimanja kalcijuma - konzumacija mlijeka tokom trudnoće, navike u smislu održavanja oralne higijene i brige o zdravlju zuba i usta, kao i navike u pogledu ishrane uopšteno¹⁰. Ovim istraživanjem potvrđene su pomenute determinante kao značajni prediktori zdravlja usta i zuba.

Zaključak

Frekvencija pranja zuba i posjeta stomatologa značajno je povezana sa zdravljem usta i zuba djece starosti od 11 do 15 godina u Crnoj Gori.

Ponašanje djece u oblasti pranja zuba značajno je uslovljeno materijalnim stanjem porodica iz kojih potiču djeca i obrazovanim statusom majki ispitivane djece.

correlated with oral diseases assessed by relevant health indicators.

Numerous studies have confirmed that there is a difference in children's attitudes towards regular dental checkups with regard to social and educational background of their families. Although children become familiar with oral hygiene very early and their parents are more and more aware of the importance of oral health to overall well-being of their children, the role of parents and their children in maintaining oral health is often not enough, so it is necessary to visit a dentist. In order to avoid caries and serious complications, a dentist should be visited regularly even if one has healthy teeth⁷.

The behavior of children is directly related to the process of socialization which is primarily taken place at their homes. Therefore, appropriate measures are needed in order to modify the behavior and they should be taken by parents⁸. The data showed that there was a difference in children's attitudes towards regular dental checkups with regard to social and educational background of their parents⁹. Obviously, the attitude that regular preventive checkups can prevent oral diseases is not present as a current practice in respondents' families. In order to avoid caries and serious complications, a dentist should be visited regularly even if one has healthy teeth.

Determinates which are recognized as significant predictors of oral diseases by most authors are as follows: family income level, education level, taking extra calcium - milk consumption during pregnancy, oral hygiene habits, and oral healthcare as well as general nutrition habits¹⁰. This study has confirmed the abovementioned determinants as significant predictors of oral health.

Conclusion

Frequency of tooth brushing and visits to a dentist are significantly correlated with oral health of children aged 11 to 15 in Montenegro.

Tooth brushing behavior of children is significantly conditioned by financial position of respondents' families as well as with education level of their mothers.

LITERATURA / REFERENCES

1. Klarić T. Pojavnost karijesa u djece s obzirom na oralno-higijenske navike i ranije karijes iskustvo. Stomatološki fakultet u Zagrebu, 2003.
2. Biesbrock AR, Walters PA, Bartizek RD. Initial impact of a national dental education program on the oral health and dental knowledge of children. *J Contemp Dent Pract*, 2003; 4(2): 1-10.
3. Chung MH, Kaste LM, Koerber A. Dental and medical students' knowledge and opinions of infant oral health. *J Dent Educ* 2006; 70(5): 511-7.
4. Selwitz RH, Ismail AI, Pitts NB. Dental caries. *Lancet*. PMID: 17208642 [PubMed - indexed for MEDLINE] 2007 Jan 6;369(9555):51-9.
5. Janjanin M. Programski zdravstveno-vaspitni rad u prevenciji karijesa. *Stom Glas S* 2000; 47 (1): 25-7.
6. Cvetković A, Vulović M, Ivanović M. Korelacija stanja zdravlja zuba i faktora sredine - ishrane, oralne higijene i pljuvačke u dece. *Stom Glasnik S* 2006; 53 (4): 217-28.
7. Almerich Silla JM, Montiel Company JM. Oral health survey of the child population in the Valencia Region of Spain. *Med Oral Patol Oral Cir Bucal*. 2006;11(4):E369-81.
8. Smyth E, Caamano F. Oral health knowledge, attitudes and practice in 12-year-old children. *Med Oral Patol Oral Cir Bucal*, 2007; 12(8): 614-20.
9. Wierzbicka M, Petersen PE, Szatko F, Dybizbanska E, Kalo I. Changing oral health status and oral health behaviour of schoolchildren in Poland. *Community Dent Health* 2002; 19(4): 243-50.
10. Truman BI, Gooch BF, Evans CA Jr. (Eds.). *The Guide to Community Preventive Services: Interventions to prevent dental caries, oral and pharyngeal cancers, and sports-related craniofacial injuries*. *Am J Prev Med* 2002;23 (1 Supp).

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PRIKAZ SLUČAJA
 CASE REPORT

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PREPROTETSKO I PROTETSKO ZBRINJAVANJE PACIJENATA SA POVREDAMA I DENTOFACIJALNIM ANOMALIJAMA - PRIKAZ SLUČAJA

PRE-PROSTHETIC AND PROSTHETIC TREATMENT OF PATIENTS WITH INJURIES AND OROFACIAL ANOMALIES - A CASE REPORT

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Sažetak

Uvod Stomatologija je nauka koja se bavi suzbijanjem, prepoznavanjem i otklanjanjem svih patoloških promena orofacijalnog sistema. Povrede orofacijalne regije su učestale poslednjih godina i ako se adekvatno ne saniraju, mogu dovesti do trajnih deformiteta i nemogućnosti adekvatnog stomatoprotetskog zbrinjavanja.

Prikaz slučaja Ovaj rad predstavlja hirurško-protetski tretman i rehabilitaciju 49-godišnjeg pacijenta sa traumatskim povredama gornje i donje vilice, promenom vertikalne dimenzije okluzije i skeletne klase III malokluzije, koja je bila prisutna i pre povređivanja. Pacijent je došao na kliniku kao hitan slučaj zbog sanacije povreda i bolova nastalih nakon pada sa visine, poremećenih funkcija orofacijalnog regiona (funkcija ishrane, gutanja, govora), otoka i kompromitovane estetike. Nakon postavljanja dijagnoze, pacijent je zbrinut hirurškim tretmanom, repozicijom i osteosintezom mini pločicama. Po završetku hirurškog tretmana, pacijent je poslat na dalji protetski tretman. Nakon svih uobičajenih i dodatnih posebnih individualnih procedura, pacijentu su urađene mobilne protezске nadoknade. Gornjom i donjom totalnom mobilnom zubnom protezom postignuti su zadovoljavajući rezultati u smislu rekonstrukcije vertikalne dimenzije okluzije, funkcije žvakanja, gutanja, fonetike i estetike stomatognatnog sistema.

Abstract

Introduction Dentistry is the science that deals with the prevention, recognition and elimination of pathological changes in the orofacial system. Injuries in the orofacial region have become more frequent in recent years, and if these injuries are not properly treated, they may lead to permanent deformity and inability for adequate stomatoprosthetic treatment.

Case Report This paper presents a surgical-prosthetic treatment and rehabilitation of a 49-year-old patient with traumatic injuries of the upper and lower jaw, changed vertical dimension of occlusion and skeletal class III malocclusion which was present before injury. The patient came to the clinic as an emergency due to injury and pain caused by falling from height, disturbed function of the orofacial region (feeding, and swallowing, speech), swelling and compromised aesthetics. After the diagnosis was made, the patient was treated surgically, by means of reposition and osteosynthesis with miniplates. Upon completion of the surgical treatment, the patient was referred for further prosthetic treatment. After all the usual and additional special individual procedures, the patient was treated with upper and lower total dentures. Treatment with upper and lower total removable dental prosthesis in this patient gave satisfactory results in terms of the reconstruction of the vertical dimension of occlusion, the functions of chewing, swallowing, phonetics and esthetics of the stomatognathic system.

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 stomatologiju Niš. Sva prava zadržana

Zaključak Dobro isplanirane i pravilno sprovedene hirurško-protetske procedure dovode do zadovoljavajućih rezultata po završetku preprotetskog i protetskog tretmana i rehabilitacije.

Cljučne reči: traume, dento-facijalne anomalije; hirurško-protetska rehabilitacija

Conclusion A well-planned and properly performed surgical-prosthetic procedure leads to satisfactory results upon completion of preprosthetic and prosthetic treatment and rehabilitation.

Key words: trauma, dentofacial anomaly, surgical-prosthetic rehabilitation

Uvod

Stomatologija je definisana kao evaluacija dijagnoze, prevencija ili lečenje nehirurških i hirurških ili srodnih bolesti, poremećaja ili stanja usne duplje, koja obuhvataju maksilofacijalnu i susedne oblasti, kao i povezane strukture njihovog uticaja na ljudsko telo, pod uslovom da od strane stomatologa, u okviru obima njegovog obrazovanja, obuke, znanja i iskustva, bude u skladu sa etikom profesije.¹

Traumatske povrede orofacijalne regije su veoma česta pojava u stomatologiji, a nedovoljno isplanirano i neadekvatno saniranje može dovesti do trajnih deformiteta i nemogućnosti adekvatnog stomatoprotetskog zbrinjavanja.² U nekim slučajevima traumatske povrede ne predstavljaju rizik po život pacijenta, ali dugoročni efekti ovakvih povreda mogu biti ozbiljni. Kod takvih pacijenata nastaju poremećaji kako u izgledu tako i u funkciji.^{3,4} U cilju uspešnijeg protetskog zbrinjavanja potrebno je sve deformitete i anomalije sanirati preprotetskim hirurškim, konzervativnim i ortodontskim tretmanom. U rešavanju kompleksnih slučajeva, kod kojih je, pored traume, prisutna i dentofacijalna anomalija, malokluzija, neophodan je multidisciplinarni pristup i saradnja lekara različitih specijalnosti. Jedna od najtežih dentofacijalnih anomalija jeste malokluzija III klase. Ovu kompleksnu anomaliju karakterišu odstupanja u razvoju mandibule i maksile u sagitalnoj ravni, gde je donja vilica prerazvijena u odnosu na gornju. Kod pacijenata sa ovom vrstom anomalije često su kompromitovane estetika i funkcija.⁵⁻⁷ Etiologija malokluzija klase III je multifaktorijalna zbog interakcije naslednih i faktora sredine. Ako su tu prisutne još i traume, tretman takvih poremećaja je jako komplikovan.⁸ Rehabilitacija i tretman ovakvih pacijenata je jako zahtevan i jedan je od vodećih ciljeva moderne stomatologije.^{9,10}

Prikaz slučaja

Pacijent starosti 49 godina primljen je kao hitan slučaj na Kliniku za stomatologiju u Nišu, u Organizacionu jedinicu za Maksilofacijalnu hirurgiju, 18.06.2012. godine, radi

Introduction

Dentistry is defined as the evaluation of diagnosis, prevention or treatment of nonsurgical or surgical, or related diseases, disorders or conditions of the oral cavity, which include maxillofacial and adjacent areas, as well as the associated structures of their influence on the human body, provided by a dentist within the scope of his education, training, knowledge and experience and in compliance with professional ethics¹.

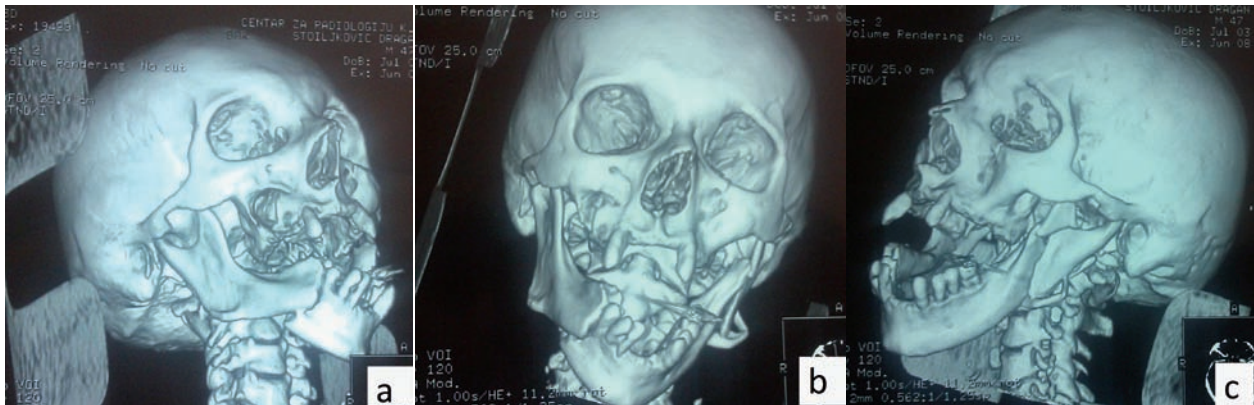
Traumatic injuries of the orofacial region are very common in dentistry and poorly planned and inadequate treatment of these injuries can lead to permanent deformity and lack of adequate stomatoprotective rehabilitation.² In some cases, traumatic injuries do not present a risk to the life of the patient but long-term effects of these injuries can be severe. In such patients, disorders occur both in appearance and in function.^{3,4} In order for prosthetic rehabilitation to be successful, all deformities and anomalies should be treated by pre-prosthetic surgical, conservative and orthodontic therapy methods. Solving complex cases in which the trauma presents the addition to already present dentofacial anomalies, such as malocclusion, requires a multidisciplinary approach and the cooperation of doctors of various specialties. One of the most difficult dentofacial anomaly is the class III malocclusion. This complex anomaly is characterized by variations in the development of the mandible and maxilla in the sagittal plane, where the lower jaw is overdeveloped in relation to the upper jaw. Patients with this malocclusion often have compromised functions⁵ and aesthetics.⁶⁻⁷ Etiology of Class III malocclusions is multifactorial, because of the interaction of hereditary and environmental factors. With the addition of trauma, the treatment of such disorders is very complicated.⁸ Rehabilitation and treatment of these patients is very demanding and is one of the major goals of modern dentistry.^{9,10}

Case Report

A patient aged 49 years, was admitted as an emergency to the Clinic of Dentistry in Niš, or-

lečenja povreda zadobijenih pri padu sa visine. Iz dostupne medicinske dokumentacije konstatuje se da je nakon hospitalizacije, kliničkog i radiološkog pregleda (Aquilion™ 64 CFX CT scanner Toshiba), postavljena dijagnoza i utvrđen prelom tela mandibule sa desne strane, kao i ugla mandibule sa leve strane (Slika 1a, 1b, 1c).

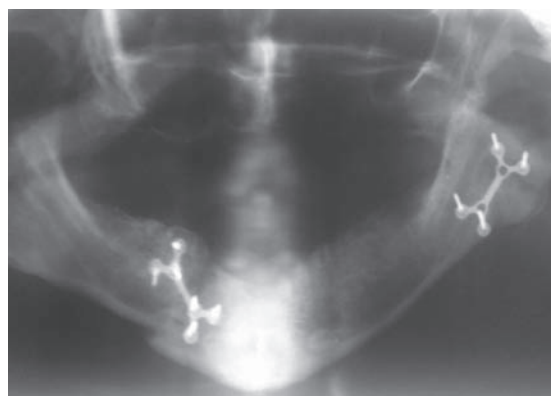
ganizational unit of Maxillofacial Surgery, on the 18th of June 2012, for treatment of injuries sustained in a fall from a height. On the basis of the available medical documentation, after hospitalization, clinical and radiological examinations (Aquilion™ 64 CFX CT Scanner Toshiba), diagnosis was made, and mandible body fracture on the right side and the angle of the mandible fracture on the left side were determined (Figure 1a, 1b, 1c).



Slika 1a, 1b, 1c. Snimak načinjen multislajsnim CT-om po prijemu pacijenta na Kliniku
Figure 1a, 1b, 1c. Video made by multislice CT after admission of the patient to the clinic

Nakon preoperativne pripreme, urađena je hirurška intervencija repozicije fragmenata mini pločicama, tj. repositio sanguina fragmentorum corpori mandibulae lat. dex. osteosynthesis cum mini plate n. i. repositio sanguina fragmentorum anguli mandibulae lat. sin. osteosynthesis cum mini plate n. i. Oseointegracija koštanih fragmenata stimulisana je nanočestičnim biokompozitom na bazi hidroksiapatita i polimera, a sa sposobnošću lokalnog dopremanja lekova. Postoperativni tok je protekao uredno (Slika 2.).

After preoperative preparation was performed, surgical repositioning of fragments with miniplates was done, i.e. Repositio sanguina fragmentorum corpori mandibulae lat. dex. osteosynthesis cum mini plate n. i. repositio sanguina fragmentorum anguli mandibulae lat. sin. osteosynthesis cum mini plate n. i. Improved osseointegration of bone fragments was stimulated with nanoparticled biocomposite based on hydroxyapatite and polymers, with drug delivery properties. The postoperative course was uneventful (Figure 2).



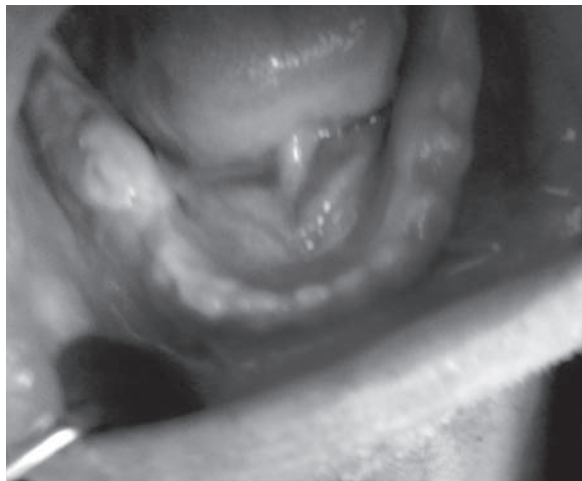
Slika 2. Ortropantomogram nakon završene hirurške intervencije
Figure 2. Panoramic radiograph after completion of surgery

Nakon perioda zarastanja čvrstih i mekih tkiva (Slika 3, 4), pacijent je upućen na dalji

After a period of hard and soft tissue healing (Fig. 3, 4), the patient was referred for further treatment for prosthetic rehabilitation of eden-

protetski tretman radi sanacije bezubosti gornje i donje vilice, kao i poremećenih funkcija orofacijelne regije (žvakanja, gutanja, govora), vertikalne dimenzije okluzije i kompromitovane estetike.

tulous jaws, and disturbed functions of orofacial region (chewing, swallowing, speech), lowered vertical dimension of occlusion and compromised aesthetics.



Slika 3. i 4. Prikaz stanja u usnoj duplji nakon oporavka od hirurške intervencije
Figure 3. and 4. Presentation of the oral cavity status after recovery from surgery

Nakon anamneze, kliničkog pregleda i pomoćnih dijagnostičkih metoda, kod pacijenta je osim navedenog postoperativnog statusa, dijagnostikovana i dentofacijalna anomalija, tj. malokluzija III klase, koja je bila prisutna i pre traumatske povrede, tj. dok je pacijent imao svoje zube. Analizom profila lica uočava se da je u biometrijskom polju gornja usna postavljena iza nosne vertikale, a donja usna i brada su pozicionirane ispred nazalne vertikale, što u potpunosti odgovara progenom profilu lica (Slika 5).

After anamnesis, physical examination and ancillary diagnostic methods, additional to his postoperative status, the patient was diagnosed with a dentofacial anomalie, i.e. class III malocclusion, which was also present before the trauma, while the patient still had his own teeth. The analysis of the facial profile showed that in the biometric field, the upper lip was placed behind the nasal vertical, and the lower lip and chin were positioned in front of the nasal vertical, which fully meets the progenic facial profil (Figure 5).



Slika 5. Progeni profil lica
Figure 5. Progenic facial profile

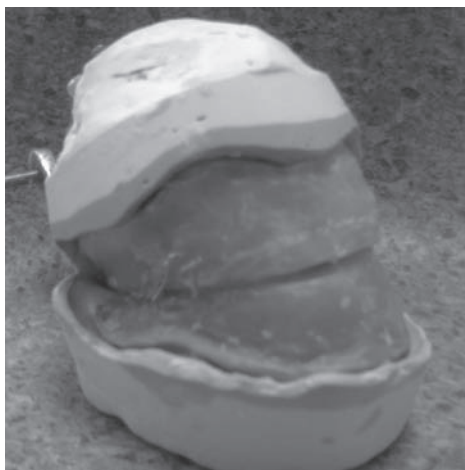
Po dolasku na Odeljenje stomatološke protektike, pacijent se požalio, pre svega, na poteškoće pri žvakanju, gutanju i govoru, i bolove u zglobovima, dok je estetika bila u drugom planu. Nakon kompletne analize, odlučili smo se za izradu gornje i donje totalne zubne proteze. Odgovarajućim standardnim kašikama uzeti su preliminarni otisci gornje i donje vilice (Hydrogum 5, Zhermack, Italy) i izliveni anatomski modeli, koji su poslužili za izradu individualnih kašika. Nakon obrade kašika, uzeti su funkcionalni otisci (Zeta, Zhermack, Italy) i izliveni definitivni radni modeli, na kojima su izrađeni šabloni, koji su poslužili za određivanje međuviličnih odnosa i postavu zuba (Slika 6, 7, 8).

After coming to the organization unit for dental prosthetics, the patient complained primarily of difficulties in chewing, swallowing and speech, and pain in the TMJ, while the aesthetic was of secondary importance. After a complete analysis, we decided to treat the patient with upper and lower complete dentures. Appropriate standard trays were used to take preliminary impressions of the upper and lower jaws (Hydrogum 5, Zhermack, Italy) and anatomical models were casted, so that the individual trays could be made on them. After the process of adjusting the trays, the functional impressions were taken (Zeta, Zhermack, Italy) and definitive work models were casted. On that models, wax rims were made, and used to determine intermaxillary relations and placement of acrylic teeth (Figure 6, 7, 8).



Slika 6, 7. Preliminarni radni modeli gornje i donje vilice

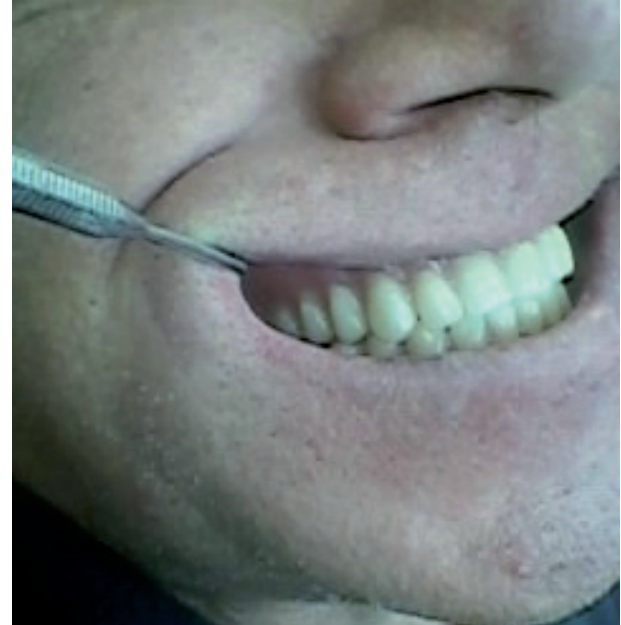
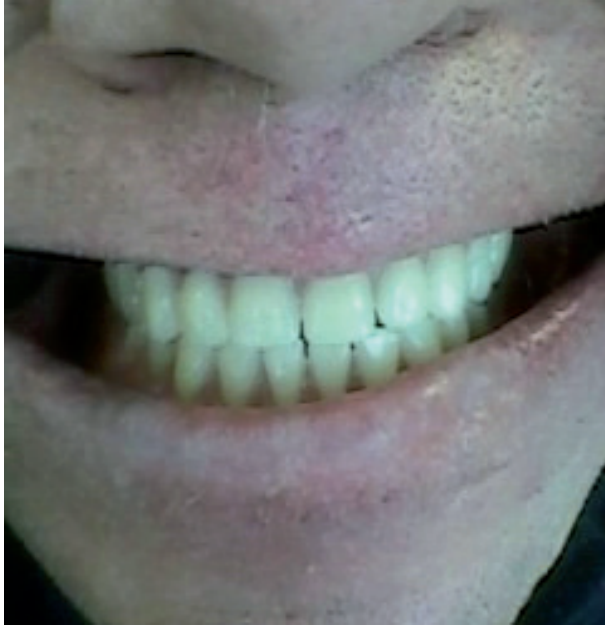
Figure 6, 7. A definitive working model of the upper and lower jaw with reconstructed jaw relationships without wax rims



Slika 8. Definitivni radni model sa rekonstruisanim međuviličnim odnosima

Figure 8. The definitive working model with reconstructed jaw relationships with wax rims

Nakon probe modela proteza, one su date na definitivno završavanje, kivetiranje i obradu. U toku predaje proteza pacijentu su data sva neophodna uputstva za njihovo korišćenje i održavanje higijene. Po završetku kombinovane hirurško-protetske terapije, uspeh lečenja prikazanog kompleksnog problema bio je očigledan (Slike 9, 10).



Slika 9, 10. Protetske nadoknade u ustima pacijenta
Figure 9, 10. Dentures in the mouth

Donja trećina lica je sada u normalnim proporcijama. Gornja usna je podržana od strane gornjih prednjih zuba i blago protrudirana u frontalnom pravcu. Progeni izgled više nije glavna karakteristika lica pacijenta. Funkcije orofacijalnog regiona su se vratile u normalne okvire (izgovor, gutanje i žvakanje), dok je bol u temporomandibularnim zglobovima (TMZ) delimično smanjen nakon predaje proteza. Kompletan nestanak tegoba od strane TMZ usledio je nekoliko meseci nakon završene protetske rehabilitacije pacijenta, nakon adaptacije na rekonstruisanu visinu zagrižaja. Pacijent je izjavio da je njegovo žvakanje znatno poboljšano. Estetski izgled pacijenta je u potpunosti zadovoljavajući.

Diskusija

Preprotetski hirurški i protetski tretman predstavljaju opciju izbora za rešavanje ovog kompleksnog slučaja.¹¹ Defekti dentofacijal-

After the model dentures were tried on in the mouth, the dental technician continued with the process of their definitive fabrication. Upon receiving the dentures, the patient was given all the necessary instructions for their use and maintenance of hygiene. After completion of the combined surgical-prosthetic therapy, success in the treatment of this complex problem was evident (Fig. 9, 10).

The lower third of the face is now within normal proportions. The upper lip is supported by the upper front teeth and mildly protruded in the frontal direction. Progenic appearance is no longer the main characteristic of the patient's face. The functions of the orofacial region are now within normal boundaries (pronunciation, swallowing and chewing), and pain in the temporomandibular joint (TMJ) was partially reduced after wearing the total dentures. The complete disappearance of the TMJ symptoms followed few months after the completion of patients rehabilitation and his adaptation to the appropriate vertical dimension of occlusion. The patient stated that his chewing significantly improved. The aesthetic appearance of the patient is satisfactory.

Discussion

Pre-prosthetic surgical treatment and prosthetic treatment present an option of choice for solving this complex case¹¹. Defects of dentofacial structures may arise as a result of trauma,

nih struktura mogu nastati kao posledica trauma, oboljenja ili kongenitalnih anomalija. U zavisnosti od lokalizacije defekta kod ovakvih pacijenta, javljaju se problemi sa govorom, žvakanjem, gutanjem, kao i estetski problemi, a mogu se javiti i depresija i posttraumatski stresni poremećaj.¹²⁻¹⁵ Najučestalija mesta na kojima dolazi do frakture mandibule jesu kondil, telo i ugao mandibule, a nešto ređe dolazi do frakture ramusa, koronoidnog i alveolarnog nastavka.¹⁶ Pravovremena terapijska procedura i fiksacija frakturiranih fragmenata omogućava brzo ozdravljenje i povratak narušenih funkcija. Mnoge tehnike se mogu koristiti za stabilizaciju i fiksaciju fragmenata. Fiksacija mora biti kruta kako bi se omogućilo zarastanje koštanog tkiva.^{3,17,18} Radiografija igra presudnu ulogu u postavljanju dijagnoze i sprovođenju terapijskih procedura. Standardna radiografija može da da približni uvid u nastalu situaciju, ali je za precizno pozicioniranje fragmenata potrebno uključivanje kompjuterizovane tomografije^{19,20}. Rut i saradnici smatraju da je primena CT snimanja potisnula panoramsku radiografiju i da je postala zlatni standard za analizu i dijagnostiku fraktura mandibule²¹. Temporomandibularni poremećaj (TMD) je takođe prisutan kod pacijenata sa traumom i malokluzijom III klase. Ovi poremećaji su posledica trauma, smetnji u žvakanju, gubitka okluzalne vertikalne dimenzije (OVD) i teškog psihološkog stanja pacijenta.²² Pacijent ima teškoća u izgovoru i otežanu mastikatornu funkciju.^{23,24} Gornjom i donjom totalnom mobilnom zubnom protezom kod pacijenta uspostavljeni su izgubljeni međuvilični odnosi, postignuti zadovoljavajući rezultati u rekonstrukciji vertikalne dimenzije okluzije, funkcije žvakanja, gutanja, fonetike i estetike stomatognatnog sistema.

Zaključak

Na osnovu prikazanog slučaja može se zaključiti da se traume orofacijalnog sistema, kombinovane sa malokluzijama III klase, kod odraslog pacijenta mogu uspešno lečiti koristeći kombinaciju hirurške i protetske terapije. Dobro isplanirane i pravilno sprovedene hirurško-protetske procedure dovode do zadovoljavajućih rezultata na kraju preprotetske i protetske rehabilitacije. Primena kombinovanih preprotetskih i protetskih procedura kod pacijenta sa traumom

disease or congenital anomalies. Depending on the localization of the defect, the problems regarding speech, chewing, and aesthetics can be found in this type of patients, and can be accompanied by depression and post-traumatic stress disorder¹²⁻¹⁵. The most common fracture localizations in the mandible are the condyle, the body and the angle of the mandible and somewhat rarer are fractures of the ramus, coronoid and alveolar process¹⁶. Timely therapeutic procedure and fixation of fractured fragments allows for fast recovery and the return of damaged functions. Many techniques can be used for the stabilization and fixation of the fragments. Fixation must be rigid to allow healing of bone tissue^{3, 17, 18}. Radiography plays a crucial role in the diagnosis and implementation of treatment procedures. Standard radiographs may give an initial insight into the situation but the precise positioning of fragments can be seen only after including computerized tomography^{19,20}. Ruth and colleagues believe that the use of CT scans has suppressed panoramic radiography and has become the gold standard for the analysis and diagnosis of fracture mandibule²¹. Temporomandibular disorder (TMD) is also present in patients with trauma and class III malocclusion. These disorders are the result of trauma, disturbances in chewing, loss of vertical dimension of occlusion (OVD), and severe psychological condition of the patient²². The patient has difficulty in pronunciation and disturbed masticatory function^{23,24}. Upper and lower total removable dental prosthesis in this patient established the lost jaw relations, achieved satisfactory results in the reconstruction of the vertical dimension of occlusion, the functions of chewing, swallowing, phonetics and esthetics of the stomatognathic system.

Conclusion

Based on the case presented, it can be concluded that the trauma of the orofacial system combined with class III malocclusion in an adult patient can be successfully treated using a combination of surgical and prosthetic treatment. A well-planned and properly performed surgical-prosthetic procedure leads to satisfactory results after pre-prosthetic and prosthetic rehabilitation. Application of combined pre-prosthetic and prosthetic procedures in patient

i dentofacijalnom anomalijom vratila je izgubljene funkcije gutanja, žvakanja, govora i estetike u zadovoljavajućem vremenskom intervalu.

with trauma and dentofacial anomaly has returned his lost functions of swallowing, chewing, speech and aesthetics in a satisfactory time frame.

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LITERATURA / REFERENCES

1. Lusardi MM, Jorge M, Nielsen CC: Orthotics and prosthetics in rehabilitation. 3 rd. Elsevier Health Sciences 2012; 532-95
2. Health Care Provider Taxonomy-Secure EDI, Version 13.0, American Medical Association 2013: 91-5.
3. Kaban LB, Pogrel MA, Perrott DH. Complications in oral and maxillofacial surgery. Philadelphia, PA: WB Saunders; 1997; 166-78.
4. Andreason JO, Andreason FM. Textbook and color atlas of traumatic injuries to the teeth, 3rd edn. St Louis, MO: Mosby; 1994: 217.
5. Ajduković Z, Janošević M, Filipović G, Arsić S, Janošević P, Petrović N. Aspects of Orthodontic-Prosthetic Rehabilitation of Dentofacial Anomalies. J Prosthodont 2013; DOI: 10.1111/jopr.12091.
6. Đorđević N, Ajduković Z, Petrović BM, Milićević J, Mitić A, Živković D, Živković M: Protetska rehabilitacija malokluzije III klase-prikaz slučaja. Praxis Medica 2010; 38 (3-4): 155-58 .
7. Timothy R. Kuntza; Robert N. Staleyb; Harold F. Bigelowc; Charles R. Kremenakb; J. Kohoutd; Jane R. Jakobsene: Arch Widths in Adults with Class I Crowded and Class III Malocclusions Compared with Normal Occlusions. Angle Orthodontist, 2008, 78, (4): 597-603.
8. Lin J, Yan Gu Preliminary investigation of nonsurgical treatment of severe skeletal class III malocclusion in the permanent dentition. Angle Orthod 2003;173:401-10.
9. Louis PJ, Gutta R, Said-Al-Naief N, et al: Reconstruction of the maxilla and mandible with particulate bone graft and titanium mesh for implant placement. J Oral Maxillofac Surg 2008; 66: 235.
10. Makridis SD: Reconstruction of alveolar defects bone implant placement. Compend Contin Edu Dent 1997; 18: 457.
11. Moy PK: Alveolar ridge reconstruction with preprosthetic surgery: a precursor to site preservation following extraction of natural dentition. Oral Maxillofac Surg Clin North Am 2004; 16: 1.
12. Rogers S, Lowe D, McNally D, et al: Health-related quality of life after maxillectomy: a comparison between prosthetic obturation and free flap. J Oral Maxillofac Surg 2003; 61: 174-81.
13. Devlin H, Barker G: Prosthetic rehabilitation of the edentulous patient requiring a partial maxillectomy. J Prosthet Dent 1992; 67: 223-27.
14. Taylor TD (ed): Clinical Maxillofacial Prosthetics. Chicago, IL, Quintessence, 2000, p. 6
15. Đorđević N, Ajduković Z, Milićević J, Petrović BM, Pešić Z: Zatvaranje perzistentne oro-nazalne fistule sa opturator protezom - prikaz slučaja. Acta Stomatologica Naissi 2012; 28(65): 1164-70.
16. Pasler FA. Radiology, color atlas of dental medicine series. New York: Thieme Medical Publishers, Inc.; 1993.
17. Doshi SS, Jayarama M, Gaikwad S, et al: Non-surgical treatment of patient with class III malocclusion and missing maxillary lateral incisors: A combined orthodontic-prosthetic approach. J Contemp Dent 2012;2:57-63.
18. Peterson LJ, Indresano AT, Marciani RD, Roser SM. Principle of oral and maxillofacial surgery, 2nd edn. Philadelphia, PA: Lippincott-Raven; 1997, pp. 397-403.
19. Shintaku WH, Venturin JS, Azevedo B, Noujeim M. Applications of cone-beam computed tomography in fractures of the maxillofacial complex. Dent Traumatol 2009; 25(4): 358-66.
20. White SC. Cone-beam imaging in dentistry. Health Phys 2008; 95(5) :628-37.
21. Roth FS, Kokoska MS, Awwad EE, et al. The identification of mandible fractures by helical computed tomography and panorex tomography. J Craniofac Surg 2005;16: 394-9.
22. Ueki K, Nakagawa K, Takatsuka S, Shimada M, Marukawa K, Takazakura D. Temporomandibular joint morphology and disc position in skeletal class III patients. J Craniomaxillofac Surg 2000; 28: 362-68.
23. Laine T: Malocclusion traits and articulatory components of speech. Eur J Orthod 1992; 14: 302-09 .
24. Hu W, Zhou Y, Fu M: Effect of skeletal Class III malocclusion on speech articulation. Chin J Stomatol 1997; 32:344-6.

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DIFERENCIJALNO-DIJAGNOSTIČKE I TERAPIJSKE KARAKTERISTIKE ORALNE KANDIDIJAZE

DIFFERENTIAL DIAGNOSIS AND THERAPEUTIC CHARACTERISTICS OF ORAL CANDIDIASIS

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Sažetak

Oralna kandidijaza je česta oportunistička infekcija u usnoj duplji izazvana prekomernim razmnožavanjem *Candide specijes* (najčešće *Candida albicans*). Kod 20-50% zdravih osoba *Candida albicans* je deo normalne flore usne duplje. Incidencija ovog oboljenja varira u zavisnosti od starosti pacijenta i predisponirajućih faktora (poremećaj funkcije pljuvačnih žlezdi – oralna suvoća, loša oralna higijena, nošenje zubnih proteza, dugotrajna upotreba lekova, ishrana zasnovana pretežno na ugljenim hidratima, pušenje, diabetes mellitus, Kušingov sindrom, maligna oboljenja, imunosupresivna stanja). Kod 2/3 bolesnika sa AIDS-om oralna kandidijaza predstavlja rani znak oboljenja.

Klinički se oralna kandidijaza manifestuje u obliku akutne (pseudomembranozna i atrofična kandidijaza) i hronične (atrofična, nodularna i mukokutanealna kandidijaza) forme.

Diferencijalno-dijagnostički kandidijaza se ubraja u bele lezije, pa je treba razlikovati od retikularne forme lihen planusa, leukoplakije, hemijskih oštećenja, mehaničkih oštećenja (kao što je grickanje oralne sluzokože), belog sunderastog nevusa, drugog stadijuma luesa, difterije i dr.

Nakon uzimanja istorije bolesti, identifikuju se i koriguju provokirajući faktori. Posle kliničkog pregleda i laboratorijske identifikacije izazivača oboljenja, primenjuju se adekvatni antifungalni lekovi: lokalno (rastvor Nistatina, Daktanol gel) ili sistemski (Flukonazol, Ketokonazol, Itrakonazol, Amfotericin B i dr.), dobra oralna higijena i sanacija zuba. Kod određenih rizičnih grupa pacijenata primenjuje se profilaksa antifungalnim lekovima koji smanjuju incidenciju i težinu oboljenja. U najvećem broju obolelih prognoza oboljenja je dobra.

Ključne reči: oralna kandidijaza, diferencijalna dijagnoza, terapija

Abstract

Oral candidiasis is a common opportunistic infection in the oral cavity and is caused by abnormal multiplication of *Candida* species (*Candida albicans*). In the 20 - 50% of healthy individuals, *Candida albicans* is a normal inhabitant of the oral cavity. The incidence of this disease varies depending on the patient's age and predisposing factors (salivary gland dysfunction - oral dryness, poor oral hygiene, wearing dentures, long-term use of drugs, diet based predominantly on carbohydrates, smoking, diabetes mellitus, Cushing's syndrome, cancer, immunosuppressive conditions). In 2/3 of patients with AIDS, oral candidiasis is an early sign of disease.

Oral candidiasis is clinically manifested as acute (pseudomembranous and atrophic candidiasis) and chronic forms (atrophic, nodular and mucocutaneous candidiasis).

Differentially, candidiasis is one of the white lesions, and should be distinguished from reticular form of lichen planus, leukoplakia, chemical damage, mechanical damage (such as biting the oral mucosa), white spongy nevus, the second stage of syphilis, diphtheria, and others.

After medical history is taken, provoking factors should be identified and corrected. Following clinical examination and laboratory identification of causative pathogens, appropriate antifungal drugs are applied: local (nystatin solution, Dactanol gel) or systemic (fluconazole, ketoconazole, itraconazole, amphotericin B, etc.), good oral hygiene and tooth repair. For certain high-risk patient groups, prophylactic antifungal drugs which reduce the incidence and severity of disease are applied. In the majority of patients, disease prognosis is good.

Key words: oral candidiasis, differential diagnosis, therapy

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 stomatologiju Niš. Sva prava zadržana

Uvod

Oralna kandidijaza je česta oportunistička infekcija u usnoj duplji izazvana preteranim razmnožavanjem *Candide* specijes. Za razvoj oralne kandidijaze najznačajnije su *Candida albicans* (najučestalija), *Candida tropicalis*, *Candida glabrata*, *Candida pseudotropicalis*, *Candida guillierimondii*, *Candida krusei*, *Candida lusitaniae*, *Candida parapsilosis* i *Candida stellatoidea*¹⁻³. *Candida albicans*, *Candida glabrata* i *Candida tropicalis* čine više od 80% izolovanih u toku kliničkih infekcija⁴. Kod 20%-50% zdravih osoba *Candida albicans* je deo normalne flore usne duplje. Zastupljenost *Candide albicans* u usnoj duplji je 45% kod novorođenčadi, 45%-65% kod zdrave dece, 30%-45% kod zdravih odraslih osoba, 50%-65% kod osoba koje nose zubne proteze, 90% kod osoba sa akutnom leukemijom, koje primaju hemoterapiju, a 95% kod pacijenata sa HIV-om^{4,5}. Može se naći kao komensal i kao oportunistički patogen u usnoj duplji, a istraživanja otkrivaju nove faktore rizika koji provociraju njenu patogenost⁶. Oralna kandidijaza je često nedijagnostikovana kod starijih osoba, a pogotovo kod onih koji nose zubne proteze. Takođe, može biti znak postojanja sistemskog oboljenja, kao što je diabetes mellitus⁴. Učestalost oralne kandidijaze je u stalnom porastu zbog sve većeg broja imunokompromitovanih pacijenata⁷.

Faktori rizika

Faktori rizika za razvitak oralne kandidijaze su: poremećaj funkcije pljuvačnih žlezda – oralna suvoća, loša oralna higijena, nošenje zubnih proteza, dugotrajna upotreba lekova (antibiotika i kortikosteroida), ishrana zasnovana pretežno na ugljenim hidratima, pušenje, diabetes mellitus, Kušingov sindrom, maligna oboljenja, imunosupresivna stanja. Kod 2/3 bolesnika sa AIDS-om oralna kandidijaza je rani znak oboljenja^{4,5}. Granulociti i makrofage smatraju se glavnim efektornim ćelijama odgovornim za kontrolu infekcija izazvanih *Candidom albicans*, a ćelijski imunitet je osnovni mehanizam odbrane domaćina od oralne kandidijaze. Mehanizmi koji dovode do smanjenog imuniteta mukoze nisu dovoljno razjašnjeni i verovatno se zasnivaju na smanjenom nivou antimikrobnih proteina pljuvačke. Pušenje i

Introduction

Oral candidiasis is a common opportunistic infection in the oral cavity caused by abnormal multiplication of *Candida* species. For the development of oral candidosis, the important ones are *Candida albicans* (the commonest), *Candida tropicalis*, *Candida glabrata*, *Candida pseudotropicalis*, *Candida guillierimondii*, *Candida krusei*, *Candida lusitaniae*, *Candida parapsilosis*, and *Candida stellatoidea*¹⁻³. *Candida albicans*, *Candida glabrata*, and *Candida tropicalis* represent more than 80% of isolates from clinical infection⁴. In the 20%-50% of healthy individuals, *Candida albicans* is a normal inhabitant of the oral cavity. The presence of *Candida albicans* in the oral cavity has been reported to be 45% in infants, 45%-65% in healthy children, 30% -45% of healthy adults, 50% -65% of people who wear removable dentures, 90% in patients with acute leukemia who received chemotherapy, and 95% in patients with HIV^{4,5}. In the oral cavity it can be found both as commensals and an opportunist pathogen and recent investigations have revealed many risk factors that provoke its pathogenicity⁶. It is common and underdiagnosed among the elderly, particularly in those who wear dental prostheses. It can also be a sign of underlying systemic diseases, such as diabetes mellitus⁴. The prevalence of candidiasis continues to escalate because of the increasing numbers of patients who are immunocompromised⁷.

Risk factors

Risk factors for the development of oral candidiasis are: salivary gland dysfunction - oral dryness, poor oral hygiene, denture wearing, long-term use of drugs (antibiotics and steroids), diet based predominantly on carbohydrates, smoking, diabetes mellitus, Cushing's syndrome, cancer, immunosuppressive conditions. In 2/3 of patients with oral candidiasis, AIDS is an early sign of disease⁴. Granulocytes and macrophages are considered to be the main effector cells responsible for the controlling infection caused by *Candida albicans*, and cell-mediated immunity is the primary host defense mechanism against oral candidiasis. Mechanisms leading to impaired oral mucosal immunity in patients are poorly understood and may

upotreba psihotropnih lekova izazivaju povišen nivo kortizola, a povećana koncentracija steroida javlja se i u toku trudnoće. Višak egzogenih ili endogenih glikokortikoida izaziva umevenu hiperglikemiju, a koncentracija glukoze u pljuvački zavisi od nivoa glukoze u krvi i korelira sa kolonizacijom usne duplje *Candida albicans*. Drugi faktori u vezi sa oralnom kandidijazom su anemija izazvana nedostatkom gvožđa i vitamina B12⁴.

Klinička slika i diferencijalna dijagnoza

Candida albicans je normalno prisutna u usnoj duplji i ne predstavlja problem kod zdravih osoba. Preterano razmnožavanje *Candide* u toku kandidijaze, ipak, može izazvati neprijatnost u ustima, poremećaj ukusa, poremećaje u ishrani, u slučaju ezofagealne kandidijaze, spor oporavak pacijenta i produžen boravak u bolnici. Kod imunokompromitovanih pacijenata infekcija se može širiti krvotokom u gornji gastrointestinalni trakt, razvijajući se u tešku infekciju sa značajnim morbiditetom i mortalitetom. Stepenn smrtnosti u slučaju sistemske kandidijaze je 71% do 79%^{4,8}.

Oralna kandidijaza se klinički manifestuje u obliku: akutne (pseudomembranozna i atrofična) i hronične (atrofične, nodularne i mukokutealne) forme^{1,2,4,9}.

Akutna pseudomembranozna kandidijaza (*Candidosis acuta pseudomembranacea*) karakteriše se izraženim belo-žućkasto-sivim pseudomembranama, sačinjenim od deskvimiranih epitelnih ćelija, fibrina i gljivičnih hifa. Promene najčešće zahvataju labijalnu i bukalnu mukožu, meko i tvrdo nepce, jezik i orofarinks. Bolesnici se žale na bljutav ukus, suvoću i peckanje. Pseudomembrane se lako skidaju, pri čemu ispod njih ostaje eritematozna mukoza. Dijagnoza je jednostavna, jer se promene lako uočavaju, a ova forma je jedna od najčešćih oblika orofaringealne kandidijaze, čineći oko trećinu svih slučajeva^{4,9}. Dijagnoza se potvrđuje kultivisanjem brisa sa zahvaćene mukoze. Često se javlja kod dece, a predisponirajući faktori za njen razvitak su starost, diabetes mellitus, HIV/AIDS, leukemija, upotreba inhalatora na bazi kortikosteroida ili antibiotika širokog spektra, terminalni stadijum teških bolesti. Diferencijalno-dijagnostički, oboljenja u us-

involve reduced levels of some of the salivary antimicrobial proteins. Smoking and use of psychotropic drugs promote hypercortisolemia, and also increased saliva concentration of steroids is a feature of pregnancy. Excess of endogenous or exogenous glucocorticoids cause moderate hyperglycemia, and glucose concentrations in saliva depend on the level of glucose in the blood and correlates with oral *Candida albicans* colonization. Other factors implicated in the aetiology of this condition are iron deficiency anaemia and vitamin B12 deficiency⁴.

Clinical and differential diagnosis

Candida albicans is a normal commensal of the mouth and generally causes no problems in healthy people. Excessive growth of candida in the thrush, however, can cause local discomfort in the mouth, taste disorder, dysphagia in the case of esophageal candidiasis resulting in poor nutrition, slow recovery and prolonged hospital stay. In immunocompromised patients, infection can spread through the bloodstream or upper gastrointestinal tract leading to severe infection with significant morbidity and mortality. Systemic candidiasis carries a mortality rate of 71% to 79%^{4,8}.

Various clinical manifestations of oral candidiasis exist: acute forms (pseudomembranous and atrophic candidiasis) and chronic forms (atrophic, nodular and mucocutaneous candidiasis)^{1,2,4,9}.

Acute pseudomembranous candidiasis (thrush) (*Candidosis acuta pseudomembranacea*) is characterised by extensive white-yellowish-gray pseudomembranes consisting of desquamated epithelial cells, fibrin, and fungal hyphae. These white patches occur on the surface of the labial and buccal mucosa, hard and soft palate, tongue, and oropharynx. Patients complain about the bland taste, dryness and burning. Pseudomembranes can easily be removed with a swab and below them remains erythematous mucosa. The diagnosis is usually simple because the changes can easily be noticed, and this form is one of the most common ones accounting for almost a third of all cases^{4,9}. Diagnosis can be confirmed microbiologically by culturing a smear from the affected mucosa. It often occurs in children and predisposing factors include extremes of age, diabetes mellitus, patients who have HIV/AIDS or leukaemia, those using steroid aerosol inhalers, broad spectrum antibiotics, and pa-

noj duplji koja se manifestuju sličnim belim promenama su: retikularni lihen planus, karcinom skvamoznih ćelija, lihenoidne reakcije, leukoplakija, hemijska oštećenja, mehanička oštećenja (grickanje oralne sluzokože), linea alba, beli sunderasti nevus, drugi stadijum luesa, difterija^{1,2,4,9}.

Akutna atrofična kandidijaza (*Candidosis acuta atrophica*) obično se povezuje sa osećajem pečenja celih ustiju ili jezika⁴. Jezik je depapiliran, svetlo crven, a ovakvo stanje se naziva „gladak antibiotski jezik“. Pored promena na jeziku, često su prisutni difuzni enantemi na tvrdom nepcu. Bolesnik se žali na peckanje u ustima, suvoću i teško formiranje zalogaja, smetaju mu začinjena hrana i gazirana pića. Ova forma oralne kandidijaze je često udružena sa oralnom suvoćom⁹. Diferencijalno-dijagnostički, treba uzeti u obzir simptom peckanja u ustima, pogotovo kod starijih pacijenata koji nose proteze ili su pod antibiotskom, citostatskom ili inhalacionom kortikosteroidnom terapijom. Značajnu pomoć u dijagnozi pruža bris zahvaćene mukoze⁴.

Hronična atrofična kandidijaza (*Candidosis chronica atrophica*) je poznata pod nazivom „stomatitis protetica“ i vidi se kao lokalizovani hronični eritem sluzokože ispod protezne ploče. Lezije su obično lokalizovane na tvrdom nepcu i alveolarnom nastavku gornje vilice, ali mogu biti prisutne i na mandibuli. Bolesnici se žale na simptome peckanja pri nošenju proteze. Pravilna dijagnoza zahteva skidanje proteza, pažljivu inspekciju i uzimanje brisa. U 65% slučajeva proteznog stomatitisa dokazano je prisustvo oralne kandidijaze^{1,2,4,10}.

Hronična nodularna (hiperplastična) kandidijaza (*Candidosis chronica hyperplastica*) obično se javlja na bukalnoj mukozu i lateralnim ivicama jezika kao prskane ili homogene bele naslage okružene enantemom koje se ne mogu skinuti^{1,2}. Ova vrsta kandidijaze povezuje se sa pušenjem i potpuno izlečenje zavisi od njegovog prestanka. Stanje se naziva i „kandida leukoplakia“ i može progredirati u izražene displastične promene i maligno alterisati. Ipak, *Candida* specijes nije uvek izolovana iz oralne leukoplakije, tako da se njeno prisustvo smatra komplikacijom prisutnog stanja, a ne njegovim izazivačem⁴. Ovo stanje se može u dijagnozi zameniti sa lihen planusom, pemfigoidom, pemfigusom i karcinomom skvamoznih ćelija^{4,9}. Slične promene, poznate kao

tients who are terminally ill. Other conditions that can give rise to white patches in the mouth are lichen planus reticularis, squamous cell carcinoma, lichenoid reaction, leukoplakia, chemical damages, mechanical damages (biting of oral mucosa), linea alba, white sponge nevus, the second stage of syphilis, diphtheria^{1,2,4,9}.

Acute atrophic candidiasis (*Candidosis acuta atrophica*) is usually associated with a burning sensation in the mouth or on the tongue⁴. The tongue may be without papillae, and this situation is called „smooth antibiotic tongue“. In addition to tongue localisation, often are present diffuse enantema on the hard palate. The patient complains of symptoms of burning in the mouth and dryness, difficulty chewing and has problems with spicy food and fizzy drinks. This form of oral candidiasis is often associated with oral dryness⁹. In the differential diagnosis, a sore tongue should be considered especially in an older patient with dentures who has received antibiotic or cytostatic therapy or who is on inhaled steroids. A smear from the affected mucosa may help diagnosis⁴.

Chronic atrophic candidiasis (*Candidosis chronica atrophica*) also known as „denture stomatitis“ is characterised by localized chronic erythema of tissues covered by dentures. Lesions are usually localized to the hard palate and maxillary alveolar process, but can also be present on alveolar process of the mandible. Patients complain of burning symptoms when wearing dentures. Proper diagnosis requires removal of dentures, careful inspection and swab taking. The presence of oral candidiasis is confirmed in 65% of denture stomatitis^{1,2,4,10}.

Chronic nodular (hyperplastic) candidiasis (*Candidosis chronica hyperplastica*) characteristically occurs on the buccal mucosa or lateral border of the tongue as speckled or homogeneous white plaques surrounded by enanthema that cannot be wiped away^{1,2}. This type of candidiasis is associated with smoking, and complete resolution depends upon cessation of smoking. The condition is also called „Candidal leukoplakia“ and can progress to severe dysplasia and malignancy. However, species of *Candida* are not always isolated from oral leukoplakia lesions so its presence is considered a complication of the present situation rather than a causative factor⁴. This condition may be confused with lichen planus, pemphigoid, pemphigus, and squamous cell carcinoma^{4,9}. Similar changes, known as the Hyperplasia palati duri papularis are seen in patients who have a high palate, and do not wear dentures. Clinically,

Hyperplasia palati durii papilaris vide se kod pacijenata koji imaju visoko nepce, a ne nose proteze. Klinički se vide brojni mali sferični nodulusi, koji su obično crvene boje⁹.

Hronična mukokutana kandidijaza je heterogena grupa kliničkih simptoma koju karakterišu promene na koži, noktima i sluzokožama. Bolest počinje u detinjstvu i obično je udružena sa brojnim imunološkim abnormalnostima u sklopu ćelijskog imuniteta. Oralne lezije su slične onima u pseudomembranoznoj formi, a kasnije mogu biti nodularne. Lezije su generalizovane, ali postoje i predilekciona mesta, kao što komisura usana, bukalna sluzokoža, jezik, nepce i usne, sa tendencijom širenja ka orofarinksu i ezofagusu. Kožne i nokatne lezije mogu biti udružene sa oralnim promenama i klinički se različito manifestuju⁹.

Medijalni romboidni glosit je hronična promena na dorzalnoj površini jezika ispred opšančanih papila na kojoj su atrofirale filiformne papile. U više od 85% slučajeva biopsijom ovog područja izoluje se *Candida* specijes. Smatra se da je u vezi sa pušenjem i inhalacijom kortikosteroida^{1,2,4,9}.

Angularni heilit se vidi kao crvena fisura na jednom ili oba ugla usana. Obično je povezan sa intraoralnom kandidijazom, ali i drugi mikroorganizmi mogu biti izazivači, kao što su stafilokoke i streptokoke. Kod starijih osoba, usled produbljivanja bora u uglovima usana i duž nazolabijalnog nabora, dolazi do stalnog vlaženja i lakšeg razvitka promena. Promene su teže kod osoba koje duži niz godina nose zubne proteze usled resorpcije alveolarnog grebena i sniženja vertikalne dimenzije lica^{1-3,9}.

Dijagnoza

Dijagnoza kandidijaze postavlja se kliničkim pregledom, direktnim mikroskopskim pregledom uzoraka sa lezija ili kulturom na specijalnim podlogama. Hronične forme zahtevaju patohistološko ispitivanje¹¹.

Terapija

Za pravilnu terapiju bitno je uzimanje adekvatne istorije bolesti, identifikacija i korekcija provocirajućih faktora. Nakon kliničke i laboratorijske identifikacije izazivača, primenjuju se

numerous small spherical nodules can be seen, usually red in color⁹.

Chronic mucocutaneous candidiasis is a heterogeneous group of clinical symptoms, characterized by lesions on the skin, nails and oral mucosa. The disease begins in childhood and is usually associated with a number of immunological abnormalities in the cellular immunity. Oral lesions are similar to those in pseudomembranous candidiasis, but later may be nodular. The lesions are generalized, but there are some predilection sites like lip commissure, buccal mucosa, tongue, palate and lips with a tendency to spread to the oropharynx and esophagus. Skin and nail lesions may be associated with oral changes and may be clinically manifested differently⁹.

Median rhomboid glossitis is a chronic symmetrical area on the dorsal surface of the tongue in the front of circumvallate papillae. In more than 85% of the area biopsy, *Candida* species are confirmed. It is believed to be associated with smoking and the use of inhaled steroids^{1,2,4,9}.

Angular cheilitis is a red fissuring on one or both corners of the mouth. It is usually associated with interoral candidiasis, and other microorganisms can be the cause, such as staphylococci and streptococci. In the elderly people due to the facial wrinkling at the corners of the mouth and along the nasolabial folds a constantly moisturized environment is created, which further favors the infection. The changes are more severe in long term denture wearers because there is resorption of bone on which the dentures rest leading to a reduction in vertical dimension of face^{1-3,9}.

Diagnosis

Diagnosis of candidiasis is done with clinical examination, direct microscopic examination of samples of lesions or cultivation on special media. Chronic forms require histopathological examination¹¹.

Treatment

For the proper treatment taking adequate history, identification and correction of provoking factors are necessary. After clinical and laboratory identification of causative pathogens good oral hygiene, tooth repair, appropriate an-

dobra oralna higijena, sanacija zuba, adekvatni antifungalni lekovi (lokalni ili sistemski) i dezinfekcija zubnih proteza¹²⁻¹⁷.

Održavanje adekvatne oralne higijene i lokalna primena antifungalnih lekova u najvećem broju slučajeva dovoljni su za terapiju nekomplikovane oralne kandidijaze. Održavanje oralne higijene obuhvata svakodnevno čišćenje zuba, obrazne sluzokože, jezika i zubnih proteza. Zubne proteze treba skidati noću ili minimum 6 sati u toku dana. Protezu treba potopiti u rastvor za održavanje zubnih proteza, kao što je hlorheksidin^{3,18-20}. Na ovaj način se eliminiše više *Candida* sa proteze nego samo četkanjem, jer je protezna površina neravna i porozna, pa *Candida* lako adherira i samo četkanjem se ne može ukloniti. Zatim, proteze treba isprati običnom vodom, jer ih hlorheksidin može prebojiti, a zatim osušiti na vazduhu, čime se dodatno uništava na njima adherirana *Candida*^{15,16}. Pre ispiranja usta antifungalnim rastvorom, neophodno je skinuti zubne proteze kako bi lek delovao i na nepčanu sluzokožu. Lek treba podržati u ustima nekoliko minuta. Rastvor nistatina i hlorheksidina ne bi trebalo koristiti zajedno, jer se međusobno inaktiviraju. Za vreme dok se usta ispiraju antifungalnim rastvorom proteze treba potopiti u rastvor hlorheksidina^{4,15,16}.

Lokalna antifungalna terapija se uvek preporučuje kao prva terapija u slučaju nekomplikovane oralne kandidijaze. Lokalnom aplikacijom leka izbegavaju se sistemski sporedni efekti i interakcija sa drugim lekovima. U slučaju da je neophodno primeniti i sistemsku terapiju, lokalna aplikacija se nastavlja, jer se na ovaj način smanjuje doza i vreme sistemske aplikacije leka. Ranijih godina dvadesetog veka lek izbora bila je gencijana violet, ali zbog sporednih efekata (kao što je prebojavanje oralne mukoze) zamenjena je nistatinom i amfotericinom B. Oni se ne resorbuju iz gastrointestinalnog trakta i lokalno deluju u usnoj duplji. Nistatin je načešće lokalno korišćen lek u terapiji oralne kandidijaze³. Nalazimo ga u obliku lingvaleta i rastvora. Kao rastvor koristi se četiri puta dnevno u trajanju od dve nedelje ili duže. Od sporednih efekata može izazvati mučninu, povraćanje i proliv. Rastvor sadrži saharozu, pa je pogodan kod bezubih pacijenata i pacijenata sa oralnom suvoćom kao što su pacijenti na zračnoj terapiji ili sa HIV-om³.

antifungal drugs (local or systemic) and disinfection of removable intraoral dental prostheses should be applied¹²⁻¹⁶.

Oral hygiene and topical antifungals are usually adequate for uncomplicated oral candidiasis. Oral hygiene involves cleaning the teeth, buccal cavity, tongue, and dentures, if present, daily. Dentures should be left out overnight or for at least six hours daily. The dentures should be soaked in a denture cleaning solution such as chlorhexidine^{3,18-20}. This is more effective in eliminating candida than brushing because dentures have irregular and porous surfaces to which candida easily adheres and brushing alone cannot remove them. Afterwards, dentures should be rinsed with water because Chlorhexidine can discolour them, and afterwards dentures should be allowed to air dry as this also kills adherent candida on dentures^{15,16}. When rinsing the mouth with the topical antifungal, dentures should be removed to allow contact between the mucosa and the antifungal. The patient should held antifungal in the mouth for a few minutes. Combining nystatin with chlorhexidine solution inactivates both drugs. Therefore, this combination should not be used. The dentures should be removed each time the mouth is rinsed with the oral antifungal preparation and the dentures should be soaked in chlorhexidine solution^{4,15,16}.

Topical antifungal therapy is the recommended first line treatment for uncomplicated oral candidiasis. The systemic adverse effects and drug interactions that occur with the systemic agents do not occur with topical agents. Where systemic treatment is needed, topical therapy should continue as this reduces the dose and duration of systemic treatment required. In the early 20th century, the treatment of choice was gentian violet, however, due to resistance development and side effects (such as staining of the oral mucosa), it was replaced by nystatin and amphotericin B. They are not absorbed from the gastrointestinal tract and are locally applied in the mouth. Nystatin is the most widely used topical agent for the treatment of oral candidiasis. It is available as an oral pastille and suspension³. It should be used as a rinse four times a day for two weeks or longer. It can cause nausea, vomiting, and diarrhoea. The oral rinse contains sucrose and is useful in edentulous patients and those with oral dryness such as patients receiving radiotherapy and those with HIV infection³.

Systemic antifungal therapy in oral candidiasis is appropriate in patients intolerant of or refractory to topical treatment and those at

Sistemska terapija oralne kandidijaze primenjuje se kod pacijenata koji su netolerantni ili ne reaguju na lokalnu terapiju i kod pacijenata koji su pod povećanim rizikom za razvitak sistemske kandidijaze. Rastvor nistatina i tablete klotrimazola sadrže visok nivo saharoze i u slučaju povećanog rizika od karijesa, postojanja diabetes mellitusa, upotrebe kortikosteroida, primenjuju se triazoli jednom dnevno (flukonazol, itraconazol). Kod imunokompromitovanih pacijenata koji imaju kandidijazu koja je rezistentna na flukonazol, primenjuje se itraconazol zbog svog šireg spektra dejstva. Ketokonazol je takođe efikasan kao i flukonazol, ali se njegova primena ne preporučuje kod starijih osoba zbog interakcija sa drugim lekovima i sporednih efekata kao što je hepatotoksičnost^{3,17}.

Antifungalni lekovi novije generacije koji se koriste u terapiji oralne kandidijaze i invazivnih gljivičnih infekcija su posakonazol, ravukanazol i ehinokandins kao što su Caspofungin, Micafungin i Anidulafungin²¹. Oni predstavljaju manje toksične alternative u odnosu na amfotericin B. Posakonazol je 2006. godine odobren za upotrebu kod invazivnih infekcija kao što su aspergiloza i kandidijaza. Ravukanazol je visokoefikasan kod mnogobrojnih gljivičnih infekcija, uključujući kandidijazu i primenjuje se u terapiji ezofagalne kandidijaze kod pacijenata sa HIV-om. Caspofungin ima inhibitoran efekat na Aspergillus i Candida specijes. Micafungin je visokoefikasan u terapiji ezofagalne kandidijaze i pokazao je manje sporednih efekata u odnosu na Caspofungin. Anidulafungin je najnoviji ehinokandin i in vitro je pokazao visoku efikasnost protiv Candide specijesa^{3,22,23}.

Novija istraživanja u oblasti terapije oralne kandidijaze sugerišu upotrebu probiotskih bakterija, za koje je već poznato da smanjuju rast patogenih mikroba^{3,24}. Takođe, uočeno je smanjenje rasta Candide upotrebom amin fluorida u vodicama za ispiranje u kombinaciji sa pastama za zube^{3,25}.

Profilaksa

Profilaksa antifungalnim lekovima kod pacijenata koji se leče od malignih oboljenja smanjuje incidenciju oralne kandidijaze. Uočeno je da je u ovim slučajevima flukonazol efikasniji od lokalne primene antifungalnih lekova.

high risk of developing systemic infections. Both nystatin oral rinses and clotrimazole troches have a high sucrose content and if tooth decay is a concern, oral candidiasis complicated by diabetes, steroid use or an immunocompromised state, triazoles (fluconazole, itraconazole) once per day have been found to be effective in these cases. Itraconazole has a wider spectrum of activity than fluconazole and is therefore valuable in salvage treatment of the immunocompromised patients with fluconazole resistant candidosis. Ketoconazole is also as effective as fluconazole and itraconazole but its use in elderly patients is not recommended due to drug interactions and side effects, which include hepatotoxicity^{3,17}.

Antifungal drugs of new generation used in the treatment of oral candidiasis and invasive fungal infections are Posaconazole, Ravukanazole, and Echinocandins such as Caspofungin, Micafungin, and Anidulafungin²¹. They are less toxic alternatives to Amphotericin B. Posaconazole was approved in 2006 for the treatment of invasive Aspergillosis and Candida infections. Ravukanazole is highly effective against many fungal infections, including candidiasis and has been used in the treatment of esophagus candidiasis in HIV (human immunodeficiency virus) patients. Caspofungin has inhibitory effects against various Aspergillus and Candida species. Micafungin is highly effective in the treatment of esophageal thrush and showed fewer side effects compared to Caspofungin. Anidulafungin is the newest echinocandin and appears to be very effective against Candida species in vitro^{3,22,23}.

Recent research in the field of treatment of oral candidiasis advise the use of probiotic bacteria which are known to reduce the growth of pathogenic microbes^{3,24}. The reduction of Candida overgrowth with the use of an amine fluoride in mouth rinse and toothpaste combination was noticed^{3,25}.

Prophylaxis

Prophylaxis with antifungal agents reduces the incidence of oral candidiasis in patients with cancer undergoing treatment and fluconazole has been found to be more effective than topical polyenes. Also, prophylaxis with antifungals reduces the incidence of oral candidiasis in patients with HIV. The use of a chlorhexidine rinse only in bone marrow transplant patients as prophylaxis was found to be very effective.

Takođe, profilaksa antifungalnim lekovima smanjuje incidenciju oralne kandidijaze kod pacijenata sa HIV-om. Profilaksa rastvorom hlorheksidina pokazala se efikasnom jedino kod pacijenata sa transplantacijom kostne srži.

Prognoza

Uz adekvatnu terapiju, prognoza oralne kandidijaze je veoma dobra kod imunokompetentnih pacijenata. Recidiv oboljenja je najčešće posledica slabe saradnje pacijenta, neadekvatnog čišćenja proteza i njihovog stalnog nošenja ili usled nemogućnosti eliminisanja predisponirajućih faktora rizika.

Zaključak

Oralna kandidijaza je oportunistička infekcija u usnoj duplji, često nedijagnostikovana kod starijih osoba, a pogotovo kod osoba koje nose zubne proteze. Može biti znak postojanja sistemskog oboljenja, a njena učestalost je u stalnom porastu zbog sve većeg broja imunokompromitovanih pacijenata, pa je od velikog značaja njeno blagovremeno otkrivanje i adekvatno lečenje, koje smanjuje mogućnost nastanka komplikacija i progresije oboljenja, a značajno unapređuje kvalitet života pacijenata.

Prognosis

With adequate treatment the prognosis is good for oral candidiasis in immunocompetent patients. Relapse is most commonly the consequence of poor compliance with therapy, failure to remove and clean dentures appropriately, or inability to resolve the predisposing factors to the infection.

Conclusions

Oral candidiasis is an opportunistic infection in the mouth often undiagnosed in the elderly, especially in people who wear dentures. It can be a sign of underlying systemic disease, and its incidence is increasing due to the growing number of immunocompromised patients. Of great importance is the timely diagnosis and treatment which reduce the possibility of complications, disease progression and significantly improve the quality of life of patients.

LITERATURA / REFERENCES

1. Zunt SL. Oral Candidiasis: Diagnosis and treatment. *JPH* 2000; 9(5): 31-6.
2. Giannini PJ, Shetty KV. Diagnosis and management of oral candidiasis. *Otolaryngol Clin North Am*. 2011;44(1):231-40.
3. Hoshi N, Mori H, Taguchi H et al. Management of oral candidiasis in denture wearers. *J Prosthodont Res* 2011;55(1):48-52.
4. Akpan A, Morgan R. Oral candidiasis. *Postgrad Med J* 2002;78:455-59.
5. Manning DJ, Coughlin RP, Poskit EM. Candida in mouth or on dummy? *Arch Dis Child* 1985;60:381-2.
6. Rex JH, Walsh TJ, Sobel JD et al. Practice guidelines for the treatment of Candidiasis. *CID* 2000;30:662-78.
7. Ship J. Diabetes and oral health. An overview. *JADA* 2003;134: 4-10.
8. López-Martínez R. Candidosis, a new challenge. *Clin Dermatology* 2010;28(2): 178-84.
9. Dangi YS, Soni ML, Namdeo KP. Oral candidiasis: a review. *Int J Pharm Pharm Sci* 2010;4:36-41.
10. Abraham CM, Haghighat N, Beach MM, Al-Hashimi I. Candidal colonization in the presence and absence of removable dental prostheses. *Tex Dent J* 2007; 124(1): 94-101.
11. Katoh T. Guidelines for diagnosis and treatment of mucocutaneous candidiasis. *Jpn J Med Mycol* 2009;50(4):207-12.
12. Sharon V, Fazel N. Oral candidiasis and angular cheilitis. *Dermatologic Therapy*. 2010;23(3): 230-42.
13. Denning DW, Hope WW. Therapy for fungal diseases: opportunities and priorities. *Trends Microbiol* 2010;18(5):195-204.
14. Scwingel AR, Barcessat ARP, Nunez SC, Ribeiro MS. Antimicrobial photodynamic therapy in the treatment of oral candidiasis in HIV-infected patients. *Photomed Las Surg* 2012;30(8):429-32.
15. Samaranayake LP, Leung WK, Jin L. Oral mucosal fungal infections. *Periodontology* 2000 2009;49(1):39-59.
16. Geerts GA, Stuhlinger ME, Basson NJ. Effect of an antifungal denture liner on the saliva yeast count in patients with denture stomatitis: a pilot study. *J Oral Rehabil* 2008; 35(9): 664-9.
17. Yehia SA, El-Gazayerly ON, Basalious EB. Fluconazole mucoadhesive buccal films: in vitro/in vivo performance. *Curr Drug Deliv* 2009; 6(1): 17-27.
18. Budtz-Jørgensen E, Løe H. Chlorhexidine as a denture disinfectant in the treatment of denture stomatitis. *Europ J Oral Sci* 2007; 80(6): 457-64.
19. Aguiar MMGB, Albuquerque RP, Marinho DS et al. Oral sustained release nystatin tablets for the treatment of oral candidiasis: formulation development and validation of UV spectrophotometric analytical methodology for content determination. *Drug Dev Ind Pharm* 2010; 36(5):594-600.
20. Samaranayake YH, Yau JYY, Thein ZM, Jayatilake JAMS, Yeung KWS, Samaranayake LP. The post-antifungal effect (PAFE) of amphotericin B, nystatin, ketoconazole and 5-fluorocytosine and its impact on the colonization traits of *Candida glabrata*. *Med Mycol*. 2010;48(5):725-34.
21. Petrikos G, Skiada A. Recent advances in antifungal chemotherapy. *Int J Antimicrob Agents* 2007; 30: 108-17.
22. Kett DH, Cubillos GF. Anidulafungin in the treatment of patients with invasive candidiasis. *Int J Antimicrob Agents* 2008; 32 (Suppl 2): 99-102.
23. Ianas V, Matthias KR, Klotz SA. Role of posaconazole in the treatment of oropharyngeal candidiasis. *Inf Drug Resistance* 2010; 3: 45-51.
24. Hatakka K, Ahola AJ, Yli-Knuutila H et al. Probiotics reduce the prevalence of oral *Candida* in the elderly-a randomized controlled trial. *J Dent Res* 2007; 86: 125-30.
25. Meurman JH, Pärnänen P, Kari K, Samaranayake L. Effect of amine fluoride-stannous fluoride preparations on oral yeasts in the elderly: a randomised placebo-controlled trial. *Gerodontology* 2009; 26(3): 202-9.