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Contents / Sadržaj

„Radi tako da princip tvoga rada
može postati princip rada svih drugih."
Imanuel Kant

U aktuelnoj društvenoj zbilji i nepresušnoj „laboratoriji prostote i laži", ova misao jednog od najvećih filozofa svih vremena bi mogla poslužiti kao varnica za iskorak iz „grotla primitivizacije" u normalnost kojoj nasušno težimo. Atmosfera „podivljale propagande" obavijena „jeftinim staniolom" nadmeno oslikava svekoliko „blagostanje" i bez ikakvog blama promoviše pseudostvarnost.

Raskošni bukvar naše stvarnosti nudi bogat repertoar svekolikih zabluda i neistina. „Filovanjem istine" pokušava se „šminkanje besmisla i zaslađivanje i ulepšavanje prostote", a „čarobnim lučem" najavljuje „svetlost nadolazećeg mraka". Badavadžije i zidari sopstvenog poniženja logikom bezočnog laskanja i ulizivanja veruju da će se sve zaboraviti onda kad „plodovi njihovog rada" padnu u blato. Beskrajna ispraznost hvalospeva tvorcu „ničega" uglavnom je „stidljiva oda" i „paradigma neukusa", ali i jasan preduslov „zloćudne kontaminacije" društvenog ambijenta. U šizofrenoj „diplomatiji ponižavanja" dodvoravanjem se samo „verifikuje prostota" kao važan mehanizam stvaranja „perpetum mobile" društva „zaslepljenih" i političkom narkozom opijenih.

Ovo najbolje potvrđuju reči nemačkog romanopisca i Nobelovca Tomasa Mana da „najbrojnije žrtve u istoriji nisu proizvod otpora nego pristajanja". U aktuelnom medijskom galimatijasu „sigurno je" jedino da politika „no kompas" uvek nudi izvestan izlaz ali i uvek promašen cilj. Zato se mora iskoračiti iz „aktuelnog blagostanja" i društvu ponuditi odgovornost i istina kao jedino prihvatljive vrednosne i moralne mantre.

Znanje, rad, odgovornost, talenat, odnosno večitost i lepota stvaralaca moraju se negovati i promovisati kao „jedini lek" u terapiji izvitoperene stvarnosti. S tim u vezi pojam „provincija" se mora tumačiti kao „geografski pojam", a ne kao „stanje svesti".

Tamo gde „kultura profita" nadkriljuje svaku duhovnost i isključuje svaku normalnost, dešava se i „isušivanje vekovnih banja", ali i rušenje zaštićenih objekata (čitaj čuvara istorije, kulture nasleđa i identiteta jednog naroda). U ovakvim vremenima je „umetnost uzdići se do jednostavnosti", kako je to govorio veliki Ivo Andrić. Važno je znanje i istinu staviti na pijedestal, a odgovornost, čestitost i hrabrost promovisati kao moralne kategorije koje mogu isčupati sopstveni život iz kandži bezizlaza aktuelne zbilje.

U društvu „pobrkanih lončića" gde se vrednuje samo mišljenje „prvorođenog" srećni su jedino oni koji nikad nisu „savijali kičmu" i oni koji i pored svih problema uspevaju da se izbore sa „netalentovanom patetikom" i sopstvenom snagom nadahnuto kreiraju izvesniju stvarnost i pristojniju budućnost.

Urednički komentar ću završiti citatom velikog Njegoša: „Svak je rođen da po jednom umre, čast i bruka žive do vjeka", jer apostrofira značaj odgovornosti u započinjanju i dugotrajnom „lečenju" aktuelnog beznađa.

Prof. dr Slavoljub Živković

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ORIGINALNI RAD

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Comparative study of caries removal using BRIX 3000 and classic mechanical method

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SUMMARY

Introduction In dental practice, despite the constant improvement of dental equipment and materials, caries removal using rotational instruments is still not a satisfactory way. The caries removal treatment constantly offers numerous alternatives in order to replace machine tools, and one of them is the chemo-mechanical method.
The aim of this paper is to examine the effectiveness of the chemo-mechanical method of caries removal using BRIX 3000 and classic method.

Material and Method We used BRIX 3000; a material intended for atraumatic caries removal. Both caries elimination methods were performed in 40 patients with evident carious lesions. Twenty patients underwent atraumatic caries removal while in the other twenty carious tissue was removed using rotating instruments.

Results BRIX 3000 was effective in caries removal. A significant reduction in the use of local anesthetics was noticed. Patients did not experience discomfort or pain during treatment with BRIX 3000, but the duration of caries removal using this atraumatic method was significantly longer than with the classic method.

Conclusion Atraumatic method of caries removal is an adequate alternative to conventional therapeutic procedures for caries removal, which finds a place in the domain of modern minimally invasive dentistry.

Keywords: BRIX 3000; caries elimination; atraumatic method

INTRODUCTION

Dental caries is bacterial disease that leads to progressive demineralization of the inorganic part of the tooth followed by enzymatic disintegration of organic component. For years, the most common way to remove caries and prepare teeth for fillings has been the use of handpieces and burs. The invasiveness of this preparative method is the cause of many side effects such as thermal damage to the pulp, excessive removal of healthy dentin as well as patient discomfort.

Enamel prisms may break during the use of burs and handpieces, not only along the edges of the cavities, but also deeper in the enamel. These cracks can potentially harbor bacteria, causing further penetration into the dentin and growth of caries lesion. When carious tooth structure is removed using burs, some of the healthy part is also removed which weakens the cavity walls and increases the possibility of tooth fracture. With the use of modern materials and adhesive systems, the need for large retention cavities has been eliminated [1].

Taking into account the negative consequences that can occur using rotary preparation techniques, and in order to preserve and protect healthy tissues, in the recent years there has been a huge development of minimally invasive methods of caries removal - air abrasion, lasers, sono-abrasion, chemo mechanical methods (CMCR) etc. [2, 3]. CMRC involves the use of gels that selectively remove softened and infected dentin which further facilitates manual excavation of caries dentin. That way painful and unpleasant sensations are reduced to minimum while there is high efficiency and the treatment is comfortable for patients [4].

BRIX 3000 is a gel containing papain (3,000 U / mg in a concentration of 10%) which was produced in 2012 by Brix Medical Science in Argentina. The unique features of this product are due to the high concentration of papain, which is bio-encapsulated using the exclusive EBE technology (Encapssulating Buffer Emulsion). It provides an ideal pH for the gel, that immobilizes enzymes and releases them during collagen proteolysis. The mechanism of action is exclusively on the necrotic dental tissue by dissolving partially degraded collagen fibers, while healthy dentin, solid and stable structure is not disturbed, as collagen fibers are not demineralized nor exposed.

Numerous scientific papers present data on the effectiveness of chemo-mechanical method of caries removal using BRIX 3000, pointing to it as an alternative to rotary handpieces. The results show complete removal of caries and clean cavity after several gel applications. These studies also include answers about patients' acceptability. Most of the respondents accepted the treatment well and they perceived it as more pleasant and less painful than the classic method of caries removal [5]. However, there are small number of studies that evaluate the effectiveness of CMRC in the adult population.

Therefore, in an attempt to bridge this gap, our study was conducted to evaluate the effectiveness of caries re-

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moval methods, in order to find the best option that will be routinely used in clinical practice. The main goal was to find method that will be successful in caries lesions removal without damaging the surrounding tooth structure, distinguishing infected dentin from healthy, reducing healthy structure removal, preserving it and stimulating the remineralization process.

The aim of this study was to compare the efficacy of two caries removal techniques, atraumatic caries removal using BRIX 3000 and classic method using rotary handpieces. Treatment duration, effectiveness in caries removal, presence/absence of pain during treatment, and patient's perception of treatment were evaluated.

Figure 1. BRIX 3000 Gel for atraumatic caries removal
Slika 1. Gel za atraumatsko uklanjanje karijesa BRIX 3000

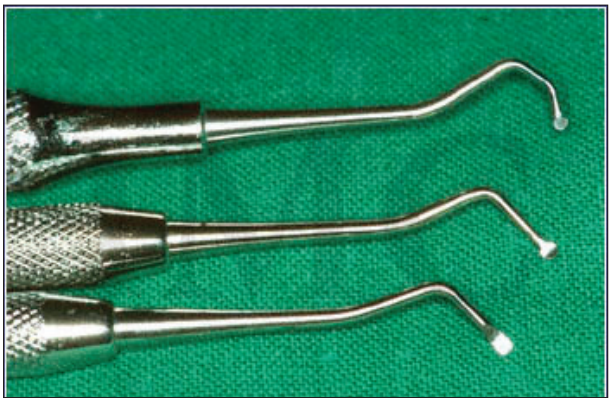


Figure 2. Different types of hand instruments – excavators
Slika 2. Različiti tipovi ručnih instrumenata – ekskavatori

MATERIAL AND METHOD

The study used the material BRIX 3000 for chemo-mechanical removal of caries with papain as its main ingredient (30,000 U/mg 10%). Papain is an endoprotein, similar to pepsin present in gastric fluid, which has bactericidal, bacteriostatic and anti-inflammatory action. 100 ml of BRIX3000 gel contains the following components: Papain 30,000 U / mg 10 g, Propylene Glycol, Citric Pectin, Triethanolamine, Sorbitan Monolaurate, Disodium Phosphate, Monopotasic Phosphate, Toluidine Blue, distilled water q.s. 100 ml.

The clinical part of the examination took place at the Clinic for Restorative Dentistry and Endodontics at the Faculty of Dentistry in Skopje. The study group consisted of patients aged 18 to 70 years of both genders, who after the examination were found to meet the criteria for the inclusion in the study:

- At least one carious lesion was found in each patient.
- The treated teeth were vital.
- Patients had previous experience at the dentist, where they were treated with similar carious lesions using a conventional method.
- The respondents in the personal history did not have data on possible allergy or hypersensitivity to drugs or other medical devices.

This study included 40 patients who were divided into two groups - experimental (20 carious teeth), where caries lesions were removed with BRIX3000 and control group (20 carious teeth), where the classic method of caries removal with handpieces and burs was used. The beginning of the preparation in both groups of respondents was conducted by using a high-speed handpiece, in order to start the preparation of the cavity.

Chemo-Mechanical Method of Caries Removal

Chemo-mechanical method of caries removal was performed by applying the BRIX 3000 gel in the cavity, where the gel was applied for about 30 seconds in order to soften the carious dentin. Then, it was removed by hand instruments – excavators (Figure 2),

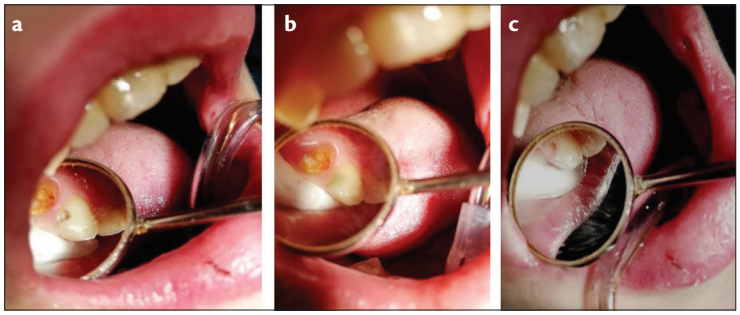
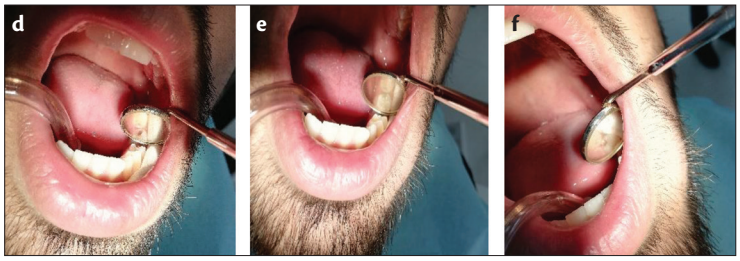


Figure 3. / Slika 3.

Case 1: / Slučaj 1:
a) tooth 13 before treatment; b) gel application and chemo-mechanical treatment; c) completed preparation of the cavity
a) zub 13 pre tretmana; b) aplikacija gela i hemomehanički tretman; c) završena preparacija kaviteta



Case 2: / Slučaj 2:
d) tooth 35 before treatment; e) gel application and chemo-mechanical treatment; f) completed preparation of the cavity
d) zub 35 pre tretmana; e) aplikacija gela i hemomehanički tretman; f) završena preparacija kaviteta

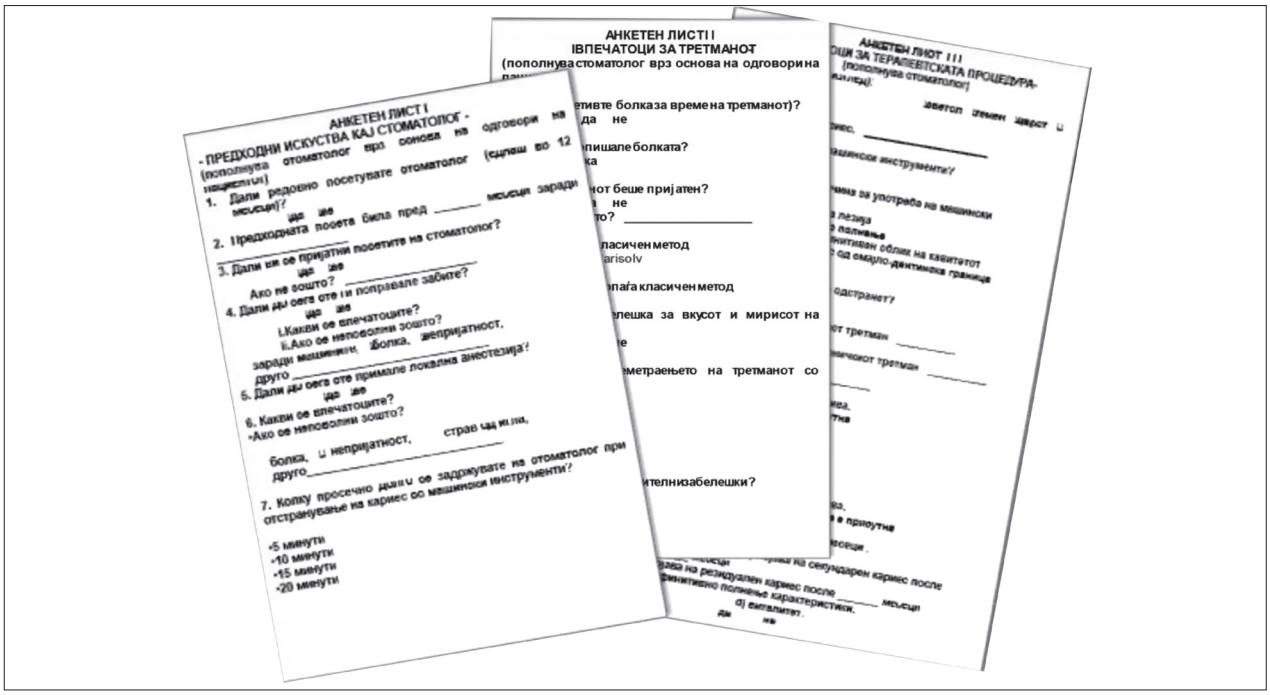


Figure 4. Preoperative and postoperative questionnaires
Slika 4. Preoperativni i postoperativni upitnik

without excesive pressure, by applying rotational movements and scratching the softened dentin. The remnants of the gel and carious tissue were removed using air. The procedure was repeated until the altered dentin was completely removed. Drying the cavity was followed by inspection, using explorer and evaluation of caries removal was done by applying the caries detector.

Conventional Method of Caries Removal

In the control group, the carious tissue was removed by machine rotating instruments and carbide borers of different shapes and sizes. The efficacy of caries removal in this group was assessed based on inspection, using explorer and application of caries detector.

In the final phase, cleaned cavities were filled with glass ionomer cements, composites or amalgam, depending on the therapist's assessment. The time required for caries removal using both methods was measured and recorded for each patient individually. The efficiency of caries removal after the application of both methods was determined under artificial lighting, by inspection, using explorer and then appropriately recorded in the questionnaire. After the completion, the patients were asked questions related to previous experiences at the dentist, perception of the treatment and comparison with the conventional method, as well as the presence and intensity of pain during caries removal. All data were recorded and separately analyzed in a previously prepared questionnaire.

RESULTS

There was no significant difference between respondents from both groups (p> 0.05) in terms of regularity of visits to the dentist (once in 12 months). However, 8 patients (40%) treated with the BRIX 3000 system, and 4 (20%) treated conventionally go to dentist once a year, while the majority of the respondents from both groups (60% of the experimental and 80% of the control group) still have no habit of annual visit to the dentist (Table 1 and Chart 1).

Table 1. Distribution of samples for the efficacy of caries removal a) experimental group and b) control group
Tabela 1. Raspodela uzoraka za procenu efikasnosti uklanjanja karijesa
a) eksperimentalna grupa i b) kontrolna grupa

	Experimental Group Eksperimentalna grupa		Control Group Kontrolna grupa	
Region Regija	N	%	N	%
Incisors Sekutići	2	10	3	15
Premolars Pretkutnjaci	7	35	8	40
Molars Kutnjaci	11	55	9	45
Total Ukupno	20	100	20	100

Subjective perception of treatment was determined as painless treatment, mild pain and severe pain. In the experimental group, 14 respondents (70%) considered the treatment painless, 4 (20%) of them had mild pain during the treatment, and only 2 (10%) described the pain as severe. On the other hand, in the control group, only 3 respondents (15%) experienced the treatment as painless, 9 (45%) had mild pain, and 8 (40%) had severe pain. This difference between the two analyzed groups was highly statistically significant (p <0.001). The patients treated with the chemo-mechanical method were significantly more likely to consider caries removal as a painless treatment than the patients treated using conventional method (Table 2 and Chart 2).

Table 2. Regular dental visits
Tabela 2. Regularne posete stomatologu

	Experimental Group Eksperimentalna grupa		Control Group Kontrolna grupa	
	N	%	N	%
Regular Regularno	8	40	4	20
Not Regular Neregularno	12	60	16	80
Total Ukupno	20	100	20	100

Yates corrected Chi-square = 0.71 p = 0.4

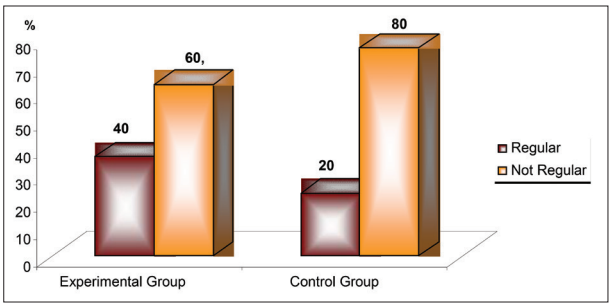
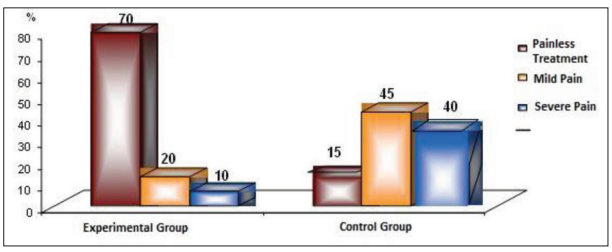


Table 3 and Chart 3 present the average durations of the preparations for the individual classes of cavities from the experimental group, as well as the shortest and the longest duration of the preparation of the cavities. Class III cavities had the lowest average preparation time of 8.0 ± 4.2 minutes, while the longest time of 12.8 ± 2.8 minutes was needed for Class II cavities.

Table 3. Subjective assessment of treatment
Tabela 3. Subjektivna procena tretmana

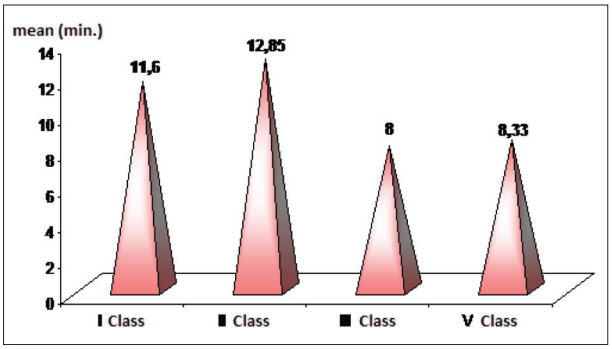
Subjective Criterion of the Patient Subjektivna procena tretmana	Experimental Group Eksperimentalna grupa		Control Group Kontrolna grupa	
	N	%	N	%
Painless Treatment Bezbolan tretman	14	70	3	15
Mild Pain Blaga osetljivost	4	20	9	45
Severe Pain Jaka bol	2	10	8	40
Total Ukupno	20	100	20	100



The duration of the preparation of the 5 classes of cavities from the control group are presented in Table 4 and Chart 4. The average duration time of preparation was the shortest for Class III of 3.3 ± 1.5 minutes and Class V of 3.6 ± 1.1 minutes, while on average the preparation time for Class II was 9.9. ± 2.5 minutes.

Table 4. Duration of cavity preparation in the experimental group
Tabela 4. Trajanje preparacije kaviteta u eksperimentalnoj grupi

	Mean Srednja vrednost	SD	Standard error Standardna greška	Min Min.	Max Maks.
Class I I klasa	11.6	1.05	0.43	5.0	20.0
Class II II klasa	12.85	2.76	0.77	10.0	18.0
Class III III klasa	8.0	4.24	3.0	5.0	11.0
Class V V klasa	8.33	2.58	1.05	5.0	12.0



The evaluation of the effectiveness of the treatment in the study was analyzed through complete or partial caries removal. Complete caries removal was achieved in 17 (85%) patients treated with the BRIX 3000 system, and in all 20 patients treated with the conventional method. This difference in the distribution of patients with completely and partially cleaned carious lesions, depending on the type of method applied was statistically not significant ($p > 0.05$) (Table 5 and Chart 5).

Table 5. Duration of cavity preparation in the control group
Tabela 5. Trajanje preparacije kaviteta u kontrolnoj grupi

	Mean Srednja vrednost	SD	Standard error Standardna greška	Min Min.	Max Maks.
Class I I klasa	6.5	4.93	1.74	5.0	20.0
Class II II klasa	9.93	2.46	0.66	5.0	14.0
Class III III klasa	3.33	1.53	0.88	2.0	5.0
Class IV IV klasa	5.50	2.12	1.50	4.0	7.0
Class V V klasa	3.6	1.14	0.51	2.0	5.0

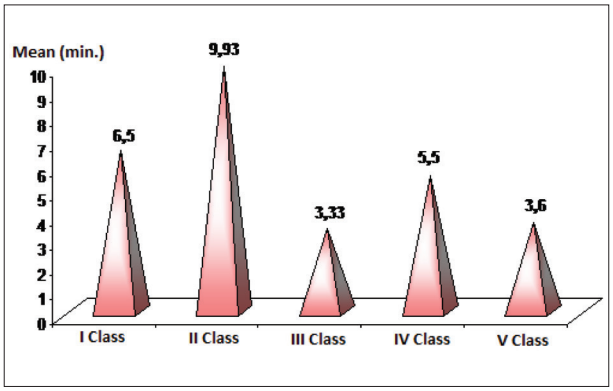
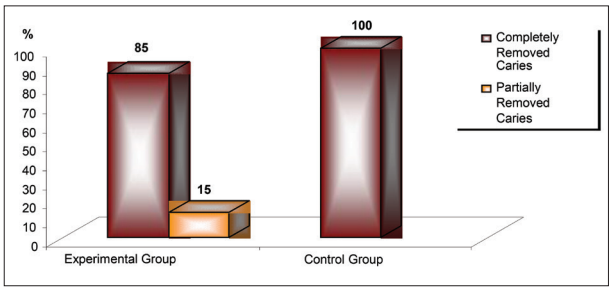


Table 6. Efficacy of caries removal treatment
Tabela 6. Efikasnost tretmana za uklanjanje karijesa

	Experimental Group Eksperimentalna grupa		Control Group Kontrolna grupa	
	N	%	N	%
Completely Removed Caries Kompletno uklonjen karijes	17	85	20	100
Partially Removed Caries Parcijalno uklonjen karijes	3	15	0	0
Total Ukupno	20	100	20	100

Fisher exact. two tailed p = 0,11



DISCUSSION

The development of systems for chemo-mechanical caries removal has come from the desire of patients for painless caries removal, without the use of drills and less unpleasant sensations [6]. These are perhaps the most common reasons for postponing dental visits, as well as regular check-ups. The data we have received from the patients regarding their consistency of visiting dentist, indicate that most of them (60% of the experimental and 80% of the control group) do not have the habit of regular annual check-ups, and the most common reasons for visiting dentist are sensitivity or painful sensations in the area of the teeth or gums (Table 1 and Chart 1).

The knowledge that this is a new and painless method that avoids the use of drills and local anesthesia, had a favorable effect on most patients and 80% of respondents expressed satisfaction with the treatment used. Patients who preferred conventional method often said the reason was the length of treatment. Most clinical studies report similar results [7–10]. The possibility of painless caries removal without prior application of local anesthesia is a great advantage of the chemo-mechanical method. This is due to the selective action of the Brix gel on carious dentin, the absence of thermal stimulation, pressure and vibrations that develop during rotary preparation. Removing caries lesions using hand instruments - excavators, additionally contributes to painless treatment, because their blades remove only carious tissue without damaging healthy dentin [11]. All patients in the experimental group had previous experience with mechanical caries removal, which enabled them to compare directly the two techniques. The knowledge that this is a new and painless method, without using drills and local anesthesia, had a favorable effect on most of them and 70% of respondents expressed satisfaction with applied treatment. Patients who preferred conventional method often indicated the length of treatment as the reason (Table 2 and Chart 2) as found similarly in other studies [8, 12, 13].

A review of the literature indicates an interesting fact about the patient's perception of the duration of treatment: a significant percentage of respondents had the impression that the removal of caries by the chemo-mechanical method lasts shorter or perhaps the same as the removal of caries with the classical method. This is probably due to less uncomfortable feeling during chemo-mechanical method due to the absence of sounds, vibrations and pain making patients more relaxed [14]. The average duration of the preparations of the individual classes of cavities within the experimental group ranged from 8 minutes for the class III cavities to 13 minutes for the class II cavities (Table 3 and Chart 3). In the control group, the duration of the preparation of the 5 classes of cavities was much shorter and ranged from 3.3 min for class III cavities to 9.93 min for class II cavities (Table 4 and Chart 4). There was a significant difference in duration of chemo-mechanical caries removal between class I and V cavities which can be explained by the fact that class V cavities are more accessible which is in accordance with the study of Alkhouli et al. [8]. Comparing duration of cavity preparation of all classes between the two groups, we found that for the class I, II and V cavities, caries removal time with BRIX was significantly longer than the same time in the control group (Table 4, 5 and Chart 4, 5).

The effectiveness of caries removal was done on the basis of standard clinical parameters - inspection under artificial lighting, using explorer and application of caries detector. In 85% of cases where chemo-mechanical method was used, complete removal of the caries lesions was achieved, while in the remaining 15% the carious lesion was partially removed. Yazici et al. found residual caries lesions in the area of the enamel-dentinal border after the use of chemo-mechanical removal in 43% [15] while Goldberg et al. found it in up to 60% of samples [16]. After chemo-mechanical removal of the caries, the surface of the dentin was blurred and without gloss, which can cause difficulties in assessing the caries status of the cavity. Caries detector has been very helpful tool for detecting sound dentin.

In clinical practice, carious lesions are often not accessible, so along with the chemo-mechanical method it is necessary to use rotating machine instruments. It has also been observed that for the treatment of initial carious lesions, the chemo-mechanical removal is not the most suitable method, which is in line with the conclusions of Chaussain-Miller et al. [17]. On the other hand, due to the selective action of carious dentin, this method reduces the risk of iatrogenic pulp opening and pushing caries dentin in deep cavities.

CONCLUSIONS

1. The chemo-mechanical method of caries removal with BRIX3000 is an effective method in clinical conditions. In some cases, it is necessary to use machine rotating instruments to provide access to the carious lesion and give a definite shape to the cavity.

Therefore, it is very important to set the correct indication for its use.

2. Chemo-mechanical treatment is usually painless, so the need for application of local anesthetics is significantly reduced. This is why it can be considered as a method of choice in anxious patients, medically handicapped patients, where local anesthesia is contraindicated, as well as in pediatric dentistry.
3. From a clinical point of view, prolonged duration of treatment is considered as a relative disadvantage of the chemo-mechanical method. But, if compared to the classical method where local anesthetics are used for pain, the overall duration of the treatment will not be very different.

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Uporedna studija upotrebe gela BRIX 3000 i klasične mehaničke metode za uklanjanje karijesnih lezija

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KRATAK SADRŽAJ

Uvod U stomatološkoj ordinaciji, uprkos stalnom usavršavanju stomatološke opreme i materijala, problem sa rotirajućim instrumentima za uklanjanje karijesa još uvek nije na zadovoljavajući način rešen. Terapija karijesa konstantno nudi brojne alternative za zamenu rotirajućih mašina, a jedna od njih je i hemomehanička metoda za eliminaciju karijesa.

Cilj ovog rada je da se ispita efikasnost hemomehaničke metode uklanjanja karijesa pomoću gela BRIX 3000, upoređujući je sa klasičnom metodom eliminacije karijesa.

Materijal i metod U studiji je korišćen BRIX 3000, materijal namenjen atraumatskom lečenju karijesa. Klinička ispitivanja efikasnosti obe metode eliminacije karijesa obavljena su kod 40 pacijenata sa evidentnim karijesnim lezijama, od kojih je 20 podvrgnuto atraumatskom tretmanu u cilju uklanjanja karijesnog tkiva, a kod preostalih 20 karijesne lezije su uklanjane rotirajućim instrumentima.

Rezultati Naša studija je pokazala efikasnost gela BRIX 3000 u uklanjanju karijesa. Podaci ukazuju na značajno smanjenje upotrebe lokalnih anestetika. Pacijenti nisu osećali nelagodnost ili bol tokom korišćenja BRIX 3000, ali je trajanje procesa eliminacije karijesa atraumatskom metodom bilo značajno duže nego klasičnom metodom.

Prema istraživanjima, može se zaključiti da je atraumatski metod uklanjanja karijesa adekvatna alternativa konvencionalnim terapijskim procedurama za uklanjanje karijesa, i on nalazi mesto u domenu savremene stomatologije i minimalne invazije.

Ključne reči: BRIX 3000; eliminacija karijesa; atraumatska metoda

UVOD

Zubni karijes je bakterijsko oboljenje koje dovodi do progresivne demineralizacije neorganskog dela zuba i praćeno je enzimskom dezintegracijom organskih komponenti zubnog tkiva. Već godinama najčešće korišćen i još uvek najaktuelniji način uklanjanja karijesa je upotreba visokoturažnih i niskoturažnih rotirajućih turbina i kolenjaka. Invazivnost ove metode je uzrok mnogih neželjenih efekata na zubna tkiva, kao što su termičko oštećenje pulpe, prekomerno uklanjanje zdravog dentina, ali i nelagodnost kod pacijenata. Gleđne prizme se mogu slomiti tokom rada ovim mašinama, ne samo duž ivica kaviteta već i dublje. Ove pukotine su mesta gde je moguć prolaz bakterija, što izaziva dalje širenje u dentin i karijesne promene.

Kada se karijes odstranjuje rotirajućim instrumentima, osim karijesa uklanja se i deo zdravog zubnog tkiva, što slabi zidove zuba i povećava mogućnost preloma. Primenom savremenih materijala i adhezivnih sistema smanjuje se potreba za velikim retencionim kavitetima i na taj način maksimalno štedi zdrava zubna materija [1].

Uzimajući u obzir negativne posledice koje mogu nastati primenom tehnika mašinske preparacije, a u cilju očuvanja i zaštite zdravih tkiva, poslednjih godina su sve više favorizovane minimalno invazivne metode uklanjanja karijesa – vazdušna abrazija, laseri, sonoabrazija, hemomehaničke metode za uklanjanje karijesa (HMUK) [2, 3]. HMUK podrazumeva upotrebu gelova koji selektivno uklanjaju omekšali, inficirani dentin, što dodatno olakšava ručnu ekskavaciju. Na taj način se bolne i neprijatne senzacije svode na minimum, podiže se stepen efikasnosti, a lečenje je prijatno za pacijente [4].

BRIX 3000 je gel koji sadrži papain (3000 U/mg u koncentraciji od 10%), koji je 2012. proizveo *Brix Medical Science* u Argentini. Jedinstvene karakteristike ovog proizvoda posledica su visoke koncentracije papaina, koji je bioinkapsuliran korišćenjem ekskluzivne tehnologije EBE tehnologije (Encapssulating Buffer Emulsion). Ovo pruža idealan pH za gel, zbog čega se enzimi imobilišu i oslobađaju tokom proteolize kolagena. Mehanizam delovanja je isključen na nekrotičnom zubnom tkivu razdvajanjem delimično degradiranih kolagenih vlakana, a na zdravom dentinu se ne narušava čvrsta i stabilna struktura, jer kolagena vlakna nisu demineralizovana niti eksponirana. Zbog toga, u pokušaju da se premosti ovaj jaz, naša studija je sprovedena kako bi se procenila efikasnost metoda uklanjanja karijesne lezije i kako bi se pronašla najbolja profesionalna praksa u upotrebi. Suština ove metode je uspešno uklanjanje karijesnih masa bez oštećenja okolnog zubnog tkiva, odvajanje inficiranog od okolnog zdravog tkiva, smanjenje uklanjanja zdrave strukture, njeno očuvanje i stimulisanje procesa remineralizacije.

MATERIJAL I METOD

U studiji smo koristili materijal BRIX 3000 za hemomehaničko uklanjanje karijesa, čiji je glavni sastojak papain (30.000 U/mg 10%). Reč je o endoproteinu, sličnom pepsinu prisutnom u gastričnoj tečnosti, koji ima bakteriološko, bakteriostatično i antiinflamatorno svojstvo. Sto mililitara gela BRIX 3000 sadrži sledeće komponente: papain 30.000 U/mg 10 g, propilen-glikol, limunski pektin, trietanolamin, sorbitan-monolaurat, disodijum-fosfat, monokalijum-fosfat, toluidin plavo, destilovanu vodu q.s. 100 ml.

Klinički deo pregleda odvijao se na Klinici za bolesti zuba i endodonciju Stomatološkog fakulteta u Skoplju. Studijsku grupu su činili pacijenti oba pola starosti od 18 do 70 godina, za koje je nakon pregleda utvrđeno da ispunjavaju kriterijume za uključivanje u studiju:

- Kod svakog pacijenta je pronađena najmanje jedna karijesna lezija;
- Lečeni zubi su bili vitalni;
- Pacijenti su imali prethodno iskustvo kod stomatologa, gde su konvencionalnom metodom imali tretman sličnih karijesnih lezija;

– Ispitanici u ličnoj anamnezi nisu imali podatke o eventualnoj alergiji ili preosetljivosti na lekove ili druga medicinska sredstva.

Ovom studijom obuhvaćeno je 40 pacijenata koji su podeljeni u dve grupe – eksperimentalnu (20 karijesnih zuba), gde je karijes bio uklonjen pomoću gela BRIX 3000 i kontrolnu grupu (20 karijesnih zuba), gde je primenjena klasična metoda uklanjanja karijesa turbinama i kolenjacima. Početak pripreme u obe grupe ispitanika sproveden je korišćenjem turbine kako bi se formirala preparacija.

Hemomehanička metoda uklanjanja karijesa

Postupak za uklanjanje karijesa sproveden hemomehaničkim putem urađen je nanošenjem gela BRIX 3000 u kavitet, gde je gel stajao oko 30 sekundi u cilju omekšavanja karijesnog tkiva. Omekšali karijes je uklonjen ručnim instrumentima – ekskavatorima (Slika 2), bez većeg pritiska, primenom rotacionih pokreta i grebanjem omekšanog dentina. Ostaci gela i karijesnog tkiva uklonjeni su pusterom. Postupak je ponavljan sve dok izmenjeni dentin nije bio potpuno uklonjen. Nakon sušenja kaviteta sledili su inspekcija, sondiranje i procena efikasnosti uklanjanja karijesa primenom detektora karijesa.

Konvencionalna metoda uklanjanja karijesa

U kontrolnoj grupi karijesno tkivo je uklonjeno mašinskim rotirajućim instrumentima i karbidnim svrdlama različitih oblika i veličina. Efikasnost uklanjanja karijesa u ovoj grupi je procenjena na osnovu inspekcije sondiranjem i primenom detektora karijesa.

U završnoj fazi svim pacijentima su ispunjeni kaviteti korišćenjem glasjonomernog cementa, kompozita ili amalgama, u zavisnosti od procene terapeuta. Vreme potrebno za uklanjanje karijesa obema metodama je mereno i evidentirano za svakog pacijenta pojedinačno.

Efikasnost uklanjanja karijesa nakon primene obe metode utvrđivana je pod veštačkim osvetljenjem, pregledom sondom, a zatim na odgovarajući način evidentirana u upitniku. Nakon rehabilitacije pacijentima su postavljana pitanja vezana za dotadašnja iskustva kod stomatologa, utiske o tretmanu i poređenje sa konvencionalnom metodom, kao i prisustvo i intenzitet bola tokom uklanjanja karijesa. Svi podaci su evidentirani i posebno analizirani u prethodno pripremljenom upitniku.

REZULTATI

Ispitanici iz obe grupe su se beznačajno razlikovali ($p > 0,05$) u pogledu redovnosti poseta stomatologu (jednom u 12 meseci). Tako osam (40%) pacijenta tretiranih sistemom BRIX 3000 i četiri (20%) tretirana konvencionalnom metodom jedanput godišnje posećuju stomatologa, dok većina ispitanika iz obe grupe (60% eksperimentalne i 80% kontrolne grupe) ipak nema naviku godišnje posete stomatologu (Tabela 1 i Grafikon 1).

Subjektivna percepcija lečenja je određena kao bezbolno lečenje, blagi bol i jaki bol. U eksperimentalnoj grupi 14 (70%) ispitanika smatralo je da je lečenje bezbolno, njih četvoro (20%) imalo je blage bolove tokom lečenja, a samo dvoje (10%) opisalo je bol kao jak. S druge strane, u kontrolnoj grupi su samo tri (15%) ispitanika doživela lečenje kao bezbolno, devet (45%) ispitanika je imalo blage bolove, a osam (40%) jake bolove. Posmatrana razlika u subjektivnom kriterijumu tretmana između ispitanika iz obe analizirane grupe je veoma statistički značajna ($p < 0,001$). Pacijenti tretirani hemomehaničkom metodom znatno češće smatraju uklanjanje karijesa bezbolnim tretmanom, suprotno od pacijenata koji su tretirani konvencionalnom metodom (Tabela 2 i Grafikon 2).

Tabela 3 i Grafikon 3 predstavljaju prosečno trajanje preparacije pojedinih klasa kaviteta iz eksperimentalne grupe, odstupanja od njih, kao i najkraće i najduže trajanje preparacije. U okviru eksperimentalne grupe, kaviteti III klase imaju najniže prosečno vreme preparacije, od $8 \pm 4,2$ minuta. Sa druge strane, najduže vreme, od $12,8 \pm 2,8$ minuta, bio je rezervisano za grupu kaviteta II klase.

Deskriptivni parametri koji opisuju trajanje preparacija svih pet klasa kaviteta iz kontrolne grupe prikazani su u Tabeli 4 i Grafikonu 4. Prosečno trajanje vremena preparacije je bilo najkraće za grupu kaviteta III klase, sa vrednošću od $3,3 \pm 1,5$ minuta, i kavitete V klase, sa vrednošću od $3,6 \pm 1,1$ minut, dok je u proseku priprema trajala najduže u grupi kaviteta II klase, $9,9 \pm 2,5$ minuta.

Procena efikasnosti tretmana u studiji analizirana je kroz kompletno ili delimično uklanjanje karijesa. Kompletno uklanjanje karijesa postignuto je kod 17 (85%) pacijenata tretiranih sistemom BRIX 3000, a kod svih 20 pacijenata tretiranih konvencionalnom metodom. Ova razlika u raspodeli pacijenata sa potpuno i delimično saniranim karijesnim lezijama u zavisnosti od vrste primenjene metode je nedovoljna da bi bila potvrđena statistički ($p > 0,05$) (Tabela 5 i Grafikon 5).

DISKUSIJA

Razvoj sistema za hemomehaničko uklanjanje karijesa proistekao je iz želje pacijenata za bezbolnim uklanjanjem karijesa, bez upotrebe mašina i sa manje neprijatnih senzacija tokom rada [6]. Ovo je možda najčešći razlog odlaganja posete stomatologu. Podaci koje smo dobili od pacijenata u vezi sa njihovom frekvencijom posete stomatologu ukazuju na to da većina njih (60% eksperimentalne i 80% kontrolne grupe) nema naviku redovnih godišnjih kontrola, a kao najčešće razloge za posetu stomatologu navode veće ili manje neprijatne senzacije u predelu zuba ili desni (Tabela 1 i Grafikon 1).

Saznanje da je ovo nova i bezbolna metoda, čijom primenom se izbegava upotreba mašinskih rotirajućih instrumenata i lokalna anestezija, povoljno je uticalo na većinu pacijenata, tako da je 80% ispitanika izrazilo zadovoljstvo primenjenim tretmanom.

Pacijenti koji su davali prednost konvencionalnu metodu često su kao razlog navodili dužinu tretmana. Većina kliničkih studija izveštava o sličnim rezultatima [7–10].

Mogućnost bezbolnog uklanjanja karijesa bez prethodne primene lokalne anesteze je velika prednost hemomehaničke metode. To je posledica selektivnog delovanja gela BRIX 3000 na karijesno izmenjenom dentinu, odsustva toplotne stimulacije, pritiska i vibracija koje se razvijaju tokom mašinske preparacije.

Tehnika uklanjanja karijesa uz pomoć ručnih instrumenata – eskavatora dodatno doprinosi bezbolnosti tretmana, jer njihova sečiva uklanjaju samo karijesno tkivo a da pritom ne oštećuju zdrav dentin [11]. Svi pacijenti u eksperimentalnoj grupi imali

su prethodno iskustvo sa mehaničkim uklanjanjem karijesa, što im je omogućilo da direktno uporede dve tehnike uklanjanja karijesa. Saznanje da je ovo nova i bezbolna metoda, kod koje se izbegavaju rotirajući mašinski instrumenti i lokalna anestezija, povoljno je uticalo na većinu njih, tako da je 70% ispitanika izrazilo zadovoljstvo primenjenim tretmanom. Pacijenti koji su davali prednost konvencionalnu metodu često su naznačili dužinu tretmana kao razlog (Tabela 2 i Grafikon 2). Većina kliničkih studija izveštava o sličnim rezultatima [8, 12, 13].

Pregled literature ukazuje na zanimljivu činjenicu o zapažanju pacijenata o trajanju tretmana: značajan procenat ispitanika imao je utisak da uklanjanje karijesa hemomehaničkom metodom traje kraće ili možda isto kao uklanjanje karijesa klasičnom metodom. To je verovatno posledica utiska da je tretman prijatniji zbog odsustva zvukova, vibracija i bolova tokom uklanjanja karijesa, što pacijente čini opuštenijima [14]. Prosečno trajanje preparacije pojedinačnih klasa kaviteta u okviru eksperimentalne grupe kretalo se od osam minuta za kavitete III klase do 13 minuta za kavitete II klase (Tabela 3 i Grafikon 3). U kontrolnoj grupi trajanje preparacije svih pet klasa kaviteta bilo je mnogo kraće i kretalo se od 3,3 minuta za kavitete III klase do 9,93 minuta za kavitete II klase (Tabela 4 i Grafikon 4).

Postojala je značajna razlika u trajanju uklanjanja karijesa hemomehaničkom metodom između kaviteta I i V klase, što se može objasniti činjenicom da su kaviteti V klase pristupačniji za obradu, što je u skladu sa studijom koju su objavili Alkhouli i saradnici [8].

Upoređujući podatke o trajanju ove dve metode, u svakoj od klasa posebno, ustanovili smo da u kavitetima I, II i V klase vreme uklanjanja karijesa sa BRIX-om traje znatno duže od vremena potrebnog za preparaciju kaviteta u kontrolnoj grupi (Tabela 3, 4 i Grafikon 3, 4).

U našoj studiji delotvornost uklanjanja karijesa procenjena je na osnovu standardnih kliničkih parametara – inspekcije pod veštačkim osvetljenjem, sondiranjem, kao i primenom detektora karijesa.

Efikasnost hemomehaničke metode uklanjanja karijesa pomoću sistema BRIX demonstrirana je uz pomoć osnovnih kliničkih parametara. U 85% slučajeva gde je ova metoda korišćena za uklanjanje karijesnog tkiva postignuto je potpuno uklanjanje karijesa, a u preostalih 15% karijesna lezija je bila delimično sanirana. Yazici sa saradnicima [15] otkrio je zaostali karijes u predelu gleđno-dentinske granice nakon primene hemomehaničkog metoda uklanjanja karijesa kod 43% uzoraka, dok ga je Goldberg sa saradnicima našao kod 60% uzoraka [16]. Nakon hemomehaničkog uklanjanja karijesa površina dentina je bila zamagljena i bez sjaja, što može izazvati poteškoće u proceni prisustva karijesa u kavitetu. Naravno, potvrdu za potpuno uklanjanje karijesnog tkiva dobili smo uz upotrebu detektora karijesa.

U kliničkoj praksi karijesne lezije često nisu pristupačne, pa je zajedno sa hemomehaničkim metodom neophodno koristiti rotirajuće mašinske instrumente. Primećeno je da za tretman početnih karijesnih lezija hemomehaničko uklanjanje karijesa nije najpogodnija metoda, što je u skladu sa zaključcima koje imaju Chaussain-Miller i saradnici [17]. S druge strane, zbog selektivnog uklanjanja karijesnog dentina ova metoda smanjuje rizik od jatrogenog otvaranja pulpe i sprečava potiskivanje karijesnih masa u slučaju dubokih kaviteta.

ZAKLJUČAK

1. Hemomehanička metoda uklanjanja karijesa gelom BRIX 3000 je efikasna metoda u kliničkim uslovima. U nekim slučajevima neophodno je koristiti mašinske rotirajuće instrumente kako bi se obezbedio pristup karijesnim lezijama i dao definitivan oblik kaviteta. Zato je veoma važno postaviti tačnu indikaciju za njegovu upotrebu.

2. Hemomehanički tretman je obično bezbolan, zbog čega je potreba za primenom lokalne anestezije znatno smanjena. Ova metoda uklanjanja karijesa je manje neprijatna za pacijente, zbog čega se može smatrati metodom izbora kod preplašenih pacijenata, medicinski hendikepiranih pacijenata, gde je lokalna anestezija kontraindikovana, kao i u pedijatrijskoj stomatologiji.

3. Sa kliničke tačke gledišta, produženo trajanje tretmana smatra se relativnim nedostatkom hemomehaničke metode. Ali ako se uporedi sa klasičnom metodom, gde se lokalna anestezija koristi za uklanjanje bola, i dalje se celokupno trajanje tretmana neće mnogo razlikovati.

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Therapeutic options in the treatment of supernumerary teeth

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SUMMARY

Introduction Hyperdontia or supernumerary teeth are excess number of teeth in comparison to normal dentition. The aim of this study was to present different variants of permanent supernumerary teeth, as well as their observation or elimination in order to prevent possible complications

Case report Six different cases of hyperdontia are presented in this paper. All hyperdontia cases were multidisciplinary evaluated and individual treatment protocols were applied. Already erupted supernumerary teeth were extracted without surgical intervention. Unerupted teeth were surgically removed or left for observation.

Conclusion Early and frequent dental check-ups are very important for children in order to detect possible dentition irregularities and thus timely start with appropriate therapy.

Keywords: hyperdontia; mesiodens; extraction; tooth eruption; fourth molars; impacted teeth

INTRODUCTION

Healthy and properly aligned teeth have always been a symbol of health and beauty. Deciduous and permanent teeth eruption control is very important in childhood, when a proper occlusion is formed [1, 2]. Tooth eruption disorder occurs due to certain pathological conditions or diseases that are mostly asymptomatic. One of the causes for tooth eruption disorders can be hyperdontia [3].

Hyperdontia or supernumerary teeth are excess teeth in comparison to normal dentition [4, 5]. Supernumerary teeth can have normal appearance, and then they are characterized as dentes supernumeraria and if they differ in appearance (conical, molariform or tuberculoid) they are named dentes accessoria. According to localization, distomolar is a tooth located distal to the third molar while peridens is localized orally or vestibulary from the alveolar ridge. Usually, mesiodens is conical in appearance, smaller than central incisors and it is localized near the midline [2, 6, 7]. If they erupt, they are located between two central incisors or on the palate [8–11].

Supernumerary teeth can cause many complications: absence of eruption and altered position of permanent teeth, teeth resorption, odontogenic cysts development, formation of diastema between central incisors, and may interfere with proper oral hygiene maintenance [1, 12, 13]. It is significant functional and aesthetic problem for young people in adolescence. Hyperdontia is mostly diagnosed accidentally, during clinical and X-ray examination, or if there is a suspicion of an obstacle to the permanent tooth eruption [5, 14, 15]. According to available literature data, the prevalence of supernumerary teeth in permanent dentition ranges between 0.15 to 3.8% [16, 17, 18].

Early treatments are needed to support right dental occlusion and prevent complications in dento-alveolar complex development [8, 16, 18]. Therefore, a multidisciplinary approach, cooperation of a pediatric dentist, orthodontist and oral surgeon is very important [16, 19, 20].

The aim of this study was to present different variants of permanent supernumerary teeth, as well as their observation or elimination in order to prevent possible complications.

CASE REPORT

Six different cases of hyperdontia are presented in this paper. The children were treated at the Specialist center for dentistry, Faculty of Medicine in Foca, Bosnia and Herzegovina. All patients with hyperdontia were male. All cases were multidisciplinary evaluated and individual treatment protocols were as follows. Supernumerary teeth that had already erupted (CASE I and II) were extracted without surgical intervention. Unerupted teeth were surgically removed or left for observation (CASES III, IV, V and VI),

Case I: A 7.5-year-old patient with erupted mesiodens in dental arch reported to the clinic. After obtaining medical and dental history, clinical examinations and X-ray

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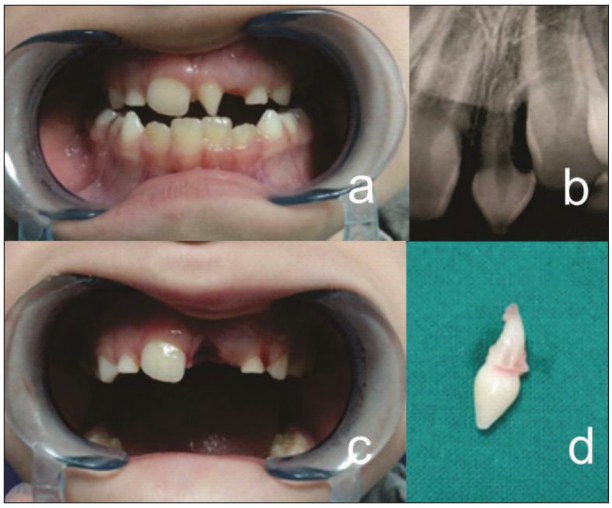

Figure 1. Erupted supernumerary tooth/mesiodens (a – clinical appearance, b – X-ray, c – extraction site, d – extracted mesiodens)
Slika 1. Iznikli prekobrojni zub/meziodens (a – klinički izgled, b – RTG snimak, c – ekstrakciona rana, d – izvađen meziodens)

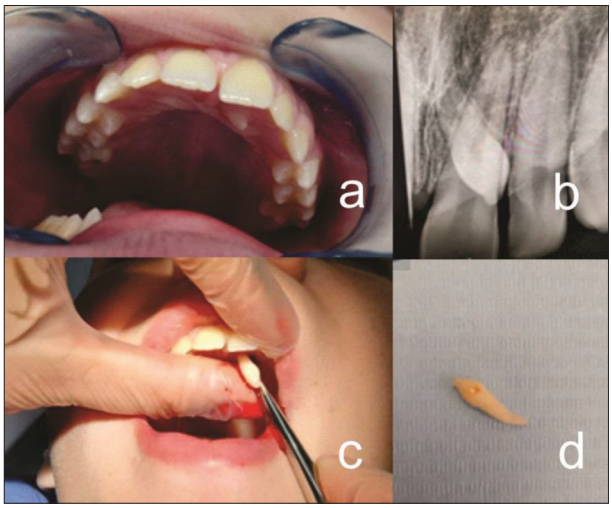

Figure 2. Erupted supernumerary tooth in the palate/mesiodens (a – clinical appearance, b – X-ray, c – tooth extraction, d – extracted mesiodens)
Slika 2. Iznikli prekobrojni zub na nepcu/meziodens (a – klinički izgled, b – RTG snimak, c –ekstrakcija zuba, d – izvađen meziodens)

imagining, the diagnosis was made. The X-ray showed that mesiodens was an obstacle to the eruption of tooth 21 (Figure 1 – a, b, c, d).

Case II: A 9.5-year-old patient reported with a mesiodens on the palate. The tooth did not inerfere with the eruption of permanent teeth. However, due to estetic reasons and in order to avoid possible complications, it was decided that the tooth should be extracted (Figure 2 - a,b,c,d). Local anesthesia was applied, and the teeth were extracted using an elevator and appropriate dental forceps. Tamponades were performed with sterile tampons. Patients were advised not to rinse their mouths. There was no need for wound suture and the extraction wounds were left to heal per primum (Case I and II).

Case III: The parents reported to the clinic with a 7-year-old boy because a year passed since the extraction of the decidous tooth (61) and the permanent has not erupted yet. After taking panoramic and periapical x ray, a

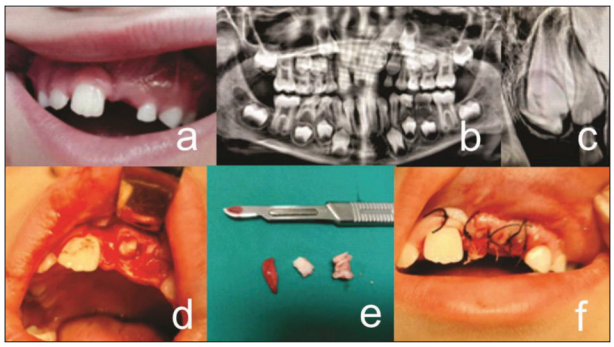

Figure 3. Unerupted tooth 21 (a – clinical appearance, b – X-ray, c – X-ray, d – extraction site, e – extracted supernumerary tooth, d – post-extraction suture)
Slika 3. Neiznikli zub 21 (a – klinički izgled, b – ortopanski snimak, c – rendgenski snimak, d – ekstrakciona rana, e – izvađen prekobrojni zub, f – postekstrakcioni šav)

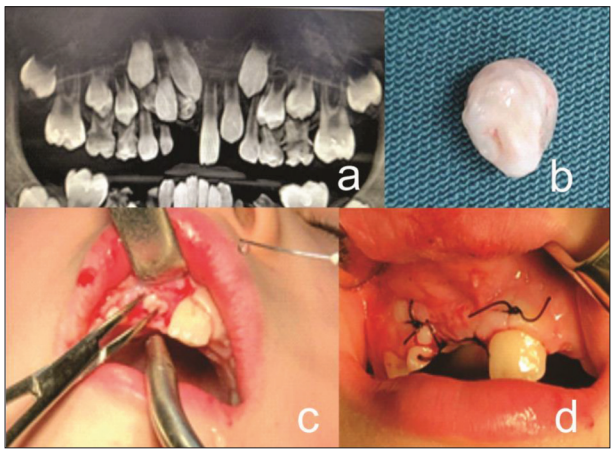

Figure 4. Unerupted tooth 11 (a – X-ray, b – extracted supernumerary tooth, c – extraction site, d – post-extraction suture)
Slika 4. Neiznikli zub 11 (a – ortopanski snimak, b – izvađen prekobrojni zub, c – ekstrakciona rana, d – postekstrakcioni šav)

mesiodens, was observed then surgically removed (Figure 3 – a, b, c, d, e, f).

Case IV: A 9-year-old patient reported to clinic due to delayed eruption of the central incisor 11. After a panoramic recording, two extra teeth were observed in the upper jaw. Mesiodens was found to be an obstacle for the eruption of tooth 11 while another supernumerary tooth was found located between teeth 13 and 14. Mesiodens was surgically removed. The other supernumerary tooth was left to be monitored for a certain period of time, as it was expected to erupt spontaneously (Figure 4 – a, b, c, d).

Case V: A 13-year-old patient, due to the persistence of the deciduous canine on the left side (73), underwent a panoramic imaging. The image showed three excess teeth and impacted canine, located below the central and lateral left incisors. One supernumerary oversized tooth had only a crown, the other one was placed horizontally and the third was placed too low in the jaw and looked like a premolar. Two of the teeth were surgically removed while the third was left to erupt spontaneously. We assumed that the affected canine would not erupt but this would certainly be monitored over time (Figure 5 – a, b, c, d, e, f).

Local anesthesia was applied and flap was designed and elevated. Then, the teeth were surgically removed using

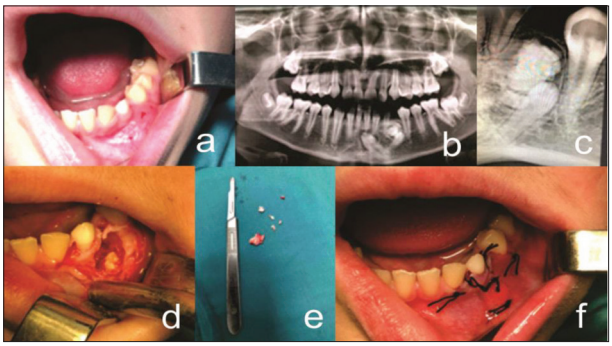

Figure 5. Persistence of the tooth 73 (a – clinical appearance, b – X-ray, c –X-ray, d – extraction site, e – extracted supernumerary tooth, f – post extraction suture)
Slika 5. Perzistencija zuba 73 (a – klinički izgled, b – ortopanski snimak, c – rendgenski snimak, d – ekstrakciona rana, e – izvađen prekobrojni zub, f – postekstrakcioni šav)

Figure 6. Panoramic image showing the buds of the fourth molars
Slika 6. Ortopanski snimak na kome su uočljivi zameci četvrtih molara

an elevator and appropriate dental forceps. Sutures were placed. Antibiotics were prescribed for seven days. Patients were advised not to rinse their mouths after the interventions, use cold compresses and seven days after surgical procedures sutures were removed (Case III, IV and V).

Case VI: During clinical examination of a 14-year-old patient it was observed that all permanent teeth were reduced in all dimensions. A panoramic image was taken to complete the diagnostic procedure. The image clearly showed the buds of the third and fourth molars in both jaws on the left and right side (Figure 6). The boy and his parents were explained that it was important for them to come for regular check-ups and that no intervention was needed at the moment.

The parents of all patients, described in this paper, were informed in detail and gave their written consent to present the cases and publish the pictures. This study was approved by the Ethics committee of the Medical faculty in Foca, No; 01-2-38.

DISCUSSION

Supernumerary teeth can erupt spontaneously or remain impacted in the jaws for life [5]. If they erupt, the most common therapeutic intervention is extraction. If they remain impacted in the alveolar ridge, there is a dilemma whether to remove them and when it is best time to do so, in order to prevent possible complications.

Supernumerary teeth can occur in both dentitions but are five times more common in permanent dentition and upper jaw [2, 14, 21, 22]. According to literature data, they are more prevalent in boys [2, 5, 14, 16, 18]. However, there are studies that show that there is no statistically significant difference in supernumerary teeth appearance in relation to gender and jaw [17, 23] as well as studies that show that hyperdontia is more prevalent in females [6]. Data from the literature indicate that mesiodens is the most common supernumerary tooth [1, 6, 14, 17, 23], although there are also studies that have reported premolars as such [3, 18, 19]. This study presented a patient who had both mesiodens and excess premolars at the same time. Supernumerary teeth can occur independently or as part of the syndromes [8, 24, 25]. One supernumerary tooth occurs in about 76–86% of cases, two in 13–23% of cases, while the incidence of multiple excess teeth is about 1% [26]. In this study, patients who had more than one excess tooth were not part of any syndrome.

The following rule applies to excess teeth: sooner they are diagnosed, better the prognosis! Treatment plan is based on medical and dental history, clinical examination, X ray and multidisciplinary evaluation that involve pediatric dentist, oral surgeon and orthodontist. It is essential to determine proper diagnosis of a particular disorder because it directs us to the best treatment strategy.

If the excess tooth interferes with normal eruption or placement of permanent tooth in its dental arch position, it is necessary to remove it. Sometimes, no intervention is needed, just regular clinical and radiological monitoring [1, 5]. The patient diagnosed with fourth molars was advised to come for regular check-ups and teeth eruption monitoring, but also the condition of the dentition. The optimal period for extraction of these teeth will be determined after consultation with an orthodontist and oral surgeon [27].

When it comes to mesiodens, there are two methods: early extraction - before the permanent incisor root formation and late extraction – after permanent incisor root formation [21, 28]. Most authors recommend mesiodens removal at an early stage in order to facilitate spontaneous emergence and proper permanent incisor placement and thus minimize the need for orthodontic treatment [25, 29]. If mesiodens is diagnosed after the tenth year of child's age, more complex surgical and orthodontic treatment will probably be needed [5]. The fact is that dentists are not always able to choose the time for extraction of excess teeth because it primarily depends on the moment when the patient reports to the clinic and the moment the diagnosis is made.

Removal of excess teeth may be an effective therapeutic procedure for elimination of aesthetic or functional dentition defects as well as prevention of possible complication.

CONCLUSION

Early and frequent dental check-ups are very important for children in order to detect possible dentition irregularities and thus timely start with appropriate therapy.

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Terapijske mogućnosti u lečenju prekobrojnih zuba

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KRATAK SADRŽAJ

Uvod Hiperdoncija (dentes supernumeraria) ili prekobrojni zubi predstavljaju povećan broj zuba u alveolarnom nastavku u odnosu na njihov normalan broj.

Cilj ovog rada bio je da se prikažu različite varijante stalnih prekobrojnih zuba, kao i njihovo posmatranje ili eliminisanje kako bi se na vreme sprečile moguće komplikacije.

Prikaz bolesnika U radu je prikazano šest različitih slučajeva hiperdoncije kod dece. Nakon konsultacije sa ortodontom i oralnim hirurgom primenjen je individualni plan terapije za svakog pacijenta. Prekobrojni zubi koji su bili već iznikli ekstrahovani su na uobičajen način bez hirurškog operativnog zahvata. Neiznikli prekobrojni zubi ekstrahovani su hirurškim putem ili su ostavljeni za praćenje.

Zaključak U dečjem uzrastu važni su rani i česti kontrolni pregledi kako bi se na vreme uočile nepravilnosti u denticiji, a samim tim i blagovremeno započelo s odgovarajućom terapijom.

Ključne reči: hiperdoncija; meziodens; vađenje zuba; nicanje zuba; četvrti molari; impaktirani zubi

UVOD

Zdravi i pravilno poređani zubi u zubnom luku oduvek su bili simbol zdravlja i lepote. U dečjem uzrastu veoma je važno kontrolisati nicanje, kako mlečnih tako i stalnih zuba, da bi se formirala pravilna okluzija [1, 2]. Poremećaj nicanja zuba nastaje usled određenih patoloških stanja ili oboljenja koja su uglavnom asimptomatska. Jedan od uzroka poremećaja nicanja zuba može biti hiperdoncija zuba [3].

Hiperdoncija ili prekobrojni zubi su stanje koje se karakteriše pojavom većeg broja zuba u alveolarnom nastavku u odnosu na njihov normalan broj [4, 5]. Prekobrojni zubi prema obliku mogu biti normalnog izgleda, i tada se nazivaju *dentes supernumeraria*, a ako izgledom odudaraju (koničan, molariformni ili tuberkuloidni) nazivaju se *dentes accessoria*. Kada je lokalizacija u pitanju, ako se prekobrojni zub pojavi distalno od trećeg molara naziva se *distomolar*, a ako je oralno ili vestibularno od zubnog luka, naziva se *peridens. Meziodens* je obično koničnog izgleda, a lokalizacija mu je u incizalnom delu u blizini linije spajanja dva maksilarna procesusa [2, 6, 7]. Manji je od susednih zuba i ako iznikne, najčešće je postavljen između centralnih sekutića ili palatinalno [8–11].

Prekobrojni zubi mogu izazvati brojne komplikacije: izostanak erupcije, izmenjen položaj stalnih zuba, resorpciju susednog zuba, razvoj odontogenih cisti, nastanak dijasteme između centralnih inciziva, a mogu i ometati izvođenje pravilne oralne higijene [1, 12, 13]. U većini slučajeva, pored funkcionalnog, prekobrojni zubi predstavljaju i značajan estetski problem mladim osobama u osetljivom periodu života. Prekobrojni zubi se dijagnostikuju tokom kliničkog pregleda ili pregleda rendgenskih snimaka, najčešće slučajno, ili u situacijama kada postoji opravdana sumnja da postoji prepreka u nicanju zuba [5, 14, 15]. Prema podacima iz literature, učestalost ove pojave u populaciji se kreće 0,15–3,8% u stalnoj denticiji [16, 17, 18].

S terapijom je najbolje započeti što pre kako bi se na vreme formirala normalna okluzija i kako bi se sprečile posledice na celi orofacijalni sistem [8, 16, 18]. Zbog toga je multidisciplinaran pristup, saradnja dečjeg stomatologa, ortodonta i oralnog hirurga, od izuzetnog značaja [16, 19, 20].

Cilj ovog rada bio je da se prikažu različite varijante stalnih prekobrojnih zuba, kao i njihovo eliminisanje kako bi se na vreme sprečile moguće komplikacije u zubnom nizu.

PRIKAZ BOLESNIKA

U radu je prikazano šest različitih slučajeva hiperdoncije kod dece koja su lečena u Specijalističkom centru za stomatologiju Medicinskog fakulteta u Foči, Bosna i Hercegovina. Pacijenti sa prekobrojnim zubima su muškog pola.

Svim pacijentima, nakon detaljnog multidisciplinarnog pregleda, primenjen je individualni plan terapije. Iznikli prekobrojni zubi (prikaz I i II) ekstrahovani su bez hirurškog operativnog zahvata. Neiznikli prekobrojni zubi su izvađeni hirurški ili su ostavljeni na posmatranje (prikaz III, IV, V i VI).

Prikaz I. Pacijentu uzrasta sedam i po godina atipičan zub je iznikao u zubnom luku. Nakon anamneze, kliničkog pregleda i rendgenskog snimka postavljena je dijagnoza. Rendgenski snimak je pokazao da iznikli meziodens predstavlja prepreku nicanju zuba 21 (Slika 1 – a, b, c, d).

Prikaz II. Pacijentu uzrasta devet i po godina meziodens je nikao na nepcu. Iznikli zub nije bio prepreka nicanju stalnih zuba. Zbog estetskih razloga ali i kako bi se sprečilo nastajanje mogućih komplikacija odlučeno je da se zub izvadi (Slika 2 – a, b, c, d).

Nakon primene lokalnog anestetika zubi su izvađeni pomoću poluge i odgovarajućih klešta. Tamponada rane je obavljena sterilnim tupferima, a pacijentima je savetovano da ne ispiraju usta. Nije bilo potrebe za ušivanjem rane, tako da je ostavljeno da rana zarste *per primum* (prikaz I i prikaz II).

Prikaz III. Roditelji su doveli dečaka uzrasta sedam godina zbog toga što je prošlo godinu dana od ekstrakcije mlečnog zuba (61), a stalni nije nicao. Nakon urađenog ortopanskog i retroalveolarnog snimka uočena je prepreka koja asocira na meziodens i koja je otklonjena hirurškim putem (Slika 3 – a, b, c, d, e, f).

Prikaz IV. Pacijent uzrasta devet godina javio se na kliniku zbog zakasnelog nicanja centralnog sekutića 11. Nakon urađenog ortopanskog snimka uočena su dva prekobrojna zuba u gornjoj vilici – meziodens, koji je prepreka nicanju zuba 11, ali i prekobojni zub koji se nalazi između zuba 13 i 14. Meziodens je hirurški odstranjen, a prekobrojni zub je ostavljen da se prati određeni period jer se moglo desiti da spontno iznikne (Slika 4 – a, b, c, d).

Prikaz V. Pacijentu uzrasta od 13 godina, zbog perzistencije mlečnog očnjaka na levoj strani (73), urađen je ortopanski snimak. Na snimku su uočena tri prekobrojna zuba i impaktiran očnjak, smešten ispod centralnih i lateralnih levih sekutića. Jedan prekobrojni zub je imao samo krunicu, drugi je bio horizontalno postavljen, a treći je bio isuviše nisko postavljen u vilici i ličio je na premolar. Hirurškim putem odstranjena su dva prekobrojna zuba, dok je treći ostavljen da spontano iznikne. Pretpostavili smo da impaktirani očnjak neće nići, ali to će se svakako vremenom pratiti (Slika 5 – a, b, c, d, e, f).

Nakon primene lokalne anestezije, napravljenog i odignutog režnja, zubi su izvađeni pomoću poluge i odgovarajućih zubnih klešta. Postavljeni su šavovi i ordinirani antibiotici narednih sedam dana. Pacijentima je dat savet da ne ispiraju ranu, da primenjuju hladne obloge spolja, kao i da nakon sedam dana dođu da im se uklone konci (prikaz III, prikaz IV i prikaz V).

Prikaz VI. Pacijentu od 14 godina urađen je klinički pregled i uočeno je da su krunice stalnih zuba smanjene u svim dimenzijama. Kako bi se postavila pravilna dijagnoza, urađen je ortopanski snimak, na kome su se jasno uočili zameci trećih i četvrtih molara u obe vilice sa leve i desne strane (Slika 6).

Dečaku i njegovim roditeljima je objašnjeno da trenutno nije potrebna stomatološka intervencija, kao i da je važno da dolaze na redovne kontrolne preglede (prikaz VI).

Svi roditelji čija su deca učestvovala u ovoj studiji, nakon detaljnog objašnjenja istraživanja, dali su usmeni i pismeni pristanak da se slučajevi opišu u radu, kao i da se prikažu fotografije. Istraživanje je odobreno od strane Etičkog komiteta Medicinskog fakulteta u Foči, broj 01-2-38.

DISKUSIJA

Prekobrojni zubi mogu spontano eruptirati ili ostati impaktirani u vilici celi život [5]. Ako izniknu, najčešća terapijska intervencija je ekstrakcija. Ukoliko ostanu u alveolarnom nastavku impaktirani, postoji dilema da li ih izvaditi i u kom periodu je to najbolje uraditi, kako bi se sprečio mogući nastanak komplikacija.

Prekobrojni zubi se mogu javiti u obe denticije, ali su pet puta češći u stalnoj denticiji i gornjoj vilici [2, 14, 21, 22]. Prema podacima iz literature prisutniji su kod dečaka [2, 5, 14, 16, 18]. Međutim, postoje i studije koje pokazuju da nema statistički značajne razlike u pojavljivanju prekobrojnih zuba u odnosu na pol i vilice [17, 23], kao i studije koje govore da je hiperdoncija prisutnija kod osoba ženskog pola [6]. Podaci iz literature ukazuju da je meziodens najčešći prekobrojni zub [1, 6, 14, 17, 23], mada postoje i studije koje su utvrdile da su to premolari [3, 18, 19]. U ovoj studiji prikazan je pacijent koji ima istovremeno meziodens i prekobrojni premolar.

Prekobrojni zubi mogu se javiti samostalno kao posebna anomalija ili u sklopu nekog sindroma [8, 24, 25]. U oko 76–86% slučajeva se javlja jedan, u 13–23% slučajeva dva, dok je incidenca višestrukih prekobrojnih zuba oko 1% [26]. U ovoj studiji pacijenti koji su imali više od jednog prekobrojinog zuba nisu bili u sklopu nekog sindroma.

Za prekobrojne zube važi pravilo: što se pre dijagnostikuju bolja je prognoza. Plan terapije je individualan za svakog pacijenta, a donosi se nakon urađene detaljne anamneze, rendgenskog snimka, kao i multidisciplinarnog pregleda koji uključuje dečjeg stomatologa, oralnog hirurga i ortodonta. Važno je utvrditi i etiologiju pojedinog poremećaja jer nas ona usmerava na izbor najbolje terapije.

Ako prekobrojni zub ometa normalno nicanje ili postavu zuba zamenika u zubnom luku, potrebno ga je ukloniti. Ukoliko ne izaziva nikakve smetnje, nije potrebna intervencija, već samo redovno kliničko i rendgensko praćenje [1, 5]. Pacijentu kome su, u ovoj studiji, dijagnostikovani četvrti molari savetovano je da dolazi na redovne kontrole, kao i da se prati nicanje zuba. Optimalan period za vađenje ovih zuba odrediće se nakon konsultacije sa ortodontom i oralnim hirurgom [27].

Kada je meziodens u pitanju, postoje dve metode: rano vađenje – pre formiranja korenova stalnih sekutića i kasno vađenje – posle formiranja korenova stalnih sekutića [21, 28]. Većina autora preporučuje vađenje u ranoj fazi kako bi se olakšalo spontano nicanje, omogućilo pravilno postavljenje sekutića i tako minimizovala potreba za ortodontskim tretmanom [25, 29]. Ako se meziodens dijagnostikuje posle desete godine deteta, verovatno će biti potrebno složenije hirurško ali i ortodontsko lečenje [5]. Činjenica je da terapeuti nisu uvek u mogućnosti birati vreme za ekstrakciju prekobrojnih zuba jer to prvenstveno zavisi od momenta kada se pacijent javi i momenta kada se postavi dijagnoza.

Uklanjanje prekobrojnih zuba predstavlja efikasan terapijski postupak zbog eventualnog otklanjanja estetskih ili funkcionalnih nedostataka u zubnom nizu, kao i sprečavanja mogućih komplikacija.

ZAKLJUČAK

U dečjem uzrastu važni su rani i česti kontrolni pregledi kako bi se na vreme uočile nepravilnosti u denticiji, a samim tim i blagovremeno započelo s odgovarajućom terapijom.

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Infection prevention and control protocols in dentistry – Canadian Guidelines

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SUMMARY

Introduction A risk of transmission of infectious diseases has always been an inherent part of dental practice. Easily communicable respiratory and blood borne diseases have prompted dental communities to establish, evaluate, update and monitor infection prevention and control (IPAC) protocols and strategies (guidelines).
The aim of this paper was to present Canadian standard protocols of infection prevention and control in dental offices, and compare them with similar guidelines available to dentists in Serbia.
Method A detailed overview of the most current IPAC guidelines and protocols provided by the College of Dental Surgeons of British Columbia in Canada has been summarized. In addition, the effect of the most recent Covid-19 pandemic on the current infection prevention and control measures in dental offices and future perspectives has been reviewed.
Conclusion Implementing infection prevention and control guidelines is essential part of practicing dentistry. Regulatory authorities have responsibility to establish and provide dentist with the most current IPAC protocols while dentists need to adopt up-to-date procedures and appropriately and consistently use them in everyday practice.
Keywords: infection control; dental protocols; infection transmission; covid-19

INTRODUCTION

A risk of transmission of infectious diseases has always been cantral part of dental practice. Blood borne diseases as well as respiratory and other illnesses have prompted dental communities to establish, evaluate, update and monitor infectious prevention and control protocols and strategies. Practicing dentists should have available *Infection Prevention and Control (IPAC) Guidelines* that would allow them to properly implement necessary infection prevention and control measures in a safe and effective manner. In Canada, each province has Dental Regulatory Authority that is responsible for establishing IPAC Guidelines and making them accessible to dental offices [1, 2]. Some IPAC protocols are available as part of continuing education for dental health care professionals in Serbia, but no detailed and complete Guidelines are available to Serbian dental communities [3].

In order to successfully design and implement effective IPAC measures it is important to understand mode of transmission of infectious diseases in dental offices. Three key elements are important: a microorganism, a susceptible host and a way to transmit a microorganism (Figure 1) [4]. Both patients and dental health providers are exposed to various bacteria (e.g. Mycobacterium tuberculosis, staphylococci, streptococci) and viruses (e.g. HBV, HCV, HIV, human herpes viruses, human papillomavirus) that can be found in oral cavity. The transmission of microorganism can be through direct contact (blood, oral fluids), indirect contact (instrument, equipment and environmental surface), droplets (contact of oral, nasal or conjunctival mucosa with droplets, spatter or spray containing microorganisms generated from an infected person, such as by coughing, sneezing or talking) and aerosol (particles of respirable size that can remain viable and airborne for extended

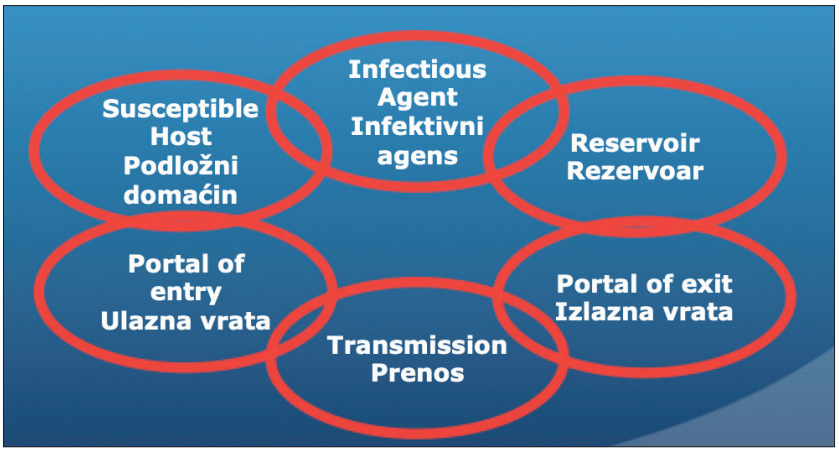

Figure 1. The chain of infection transmission
Slika 1. Lanac transmisije infekcije

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periods in the indoor environment formed while using ultrasonic scaler, handpieces or air water syringes) [5].

Looking at infection prevention and control historically there have been several cornerstones. In 1900's Louise Paster confirmed the existence of microorganisms in the air and Lister introduced asepsis [6, 7]. During 1950's ultrasonic scalers and handpieces were introduced in dental practice which led to use of high-volume suction, rubber dam, good ventilation, preoperative mouth rinse, masks and glasses, burs disinfection, wiping down the chair and other surfaces between patients and spraying the operating area at the end of the day [8]. Likely one of the most important cornerstones in dentistry was in the 1980's with emergence of HIV, and increasing prevalence of hepatitis B and C when universal precautions were introduced and instrument sterilization and use of gloves become standard [9]. Recently, Covid-19 pandemic has added to infection prevention and control rules and regulations mostly in personal protective equipment for dental health professionals and screening patients [9]. Therefore, IPAC guidelines should be considered as variable document that needs to be constantly updated.

As per Canadian Dental Association (CDA) there are seven IPAC principles [1]:

1. Patient assessment
2. Routine practices
3. Using barrier techniques
4. Applying the principles of cleaning, disinfecting, sterilizing and storing dental instruments
5. Environmental cleaning
6. Care of the overall office setting
7. Safe handling and waste disposal

Patient assessment

From time-to-time patients that don't feel well will visit dental office. Their condition may be related to dental problem they have or they can have severe respiratory illness (influenza, flu, covid-19). It is important to screen every patient, find out reason for visit, reschedule if possible or handle patient in a way to protect dental health care provider (DHCP) and other patients from transmission of infection.

Routine Practices

Health Canada uses term routine practices to describe basic standards of infection practices, and that equals "standard precautions" by CDC in The United States. Routine practices are based on concept that all patients are potentially infective even if asymptomatic and safe standards should be routinely applied to every contact with blood, body fluids, oral mucosa and non-intact skin and all instruments used potentially contaminated with infectious agents.

Routine practices rely on four principles:

- Risk assessment
- Hand hygiene
- Use of personal protective equipment (PPE)
- Safe handling and disposal of sharps and contaminated waste

Risk assessment must be done before each interaction with the patient to determine which interventions are required to prevent the transmission of infection. The risk depends on the type of dental procedure and likelihood of exposure to blood, body fluids and secretions, non-intact skin and mucous membranes. Things to consider are patient health status, cooperation, physical environment, and immune status of DHCP.

Hand hygiene is single the most important measure for preventing transmission of microorganisms. Term hand hygiene replaces hand washing with soap and alcohol-based hand rub. Both of these measures are equally effective unless hands are visibly soiled. To appropriately wash hands, liquid plain or antibacterial soap should be used, applied to wet hands and used minimally 15-20 sec thoroughly cleaning all areas of hands. After rinsing, dry paper towel should be used. Hands should be washed:

1. Before putting and after removing gloves
2. Before and after direct contact with patient
3. After touching environmental surfaces, instruments, equipment…
4. Before and after eating and drinking
5. After performing personal body functions.

Hand rub should be performed using 70-90% alcohol-based sanitizers following manufacturer instructions.

Using barrier technique

When we talk about PPE we mostly think about PPE for DHCP but there is also PPE for patient in the form of protective barriers and techniques to shield patients from potentially infectious material. Protective eyewear, dental bibs, rubber-dam etc. should be routinely used in everyday practice.

Extreme care must be taken at all times while using sharps, during cleanup and disposal to ensure all patients are protected from injuries involving sharp objects. All sharps must be disposed in safely manner in puncture resistant containers. Preventing injuries involving sharps is the key but in the cases of exposure (either cut or puncture) it is important to appropriately manage the accident.

Dentists and other dental professionals are more likely to comply with IPAC protocols if they understand them, therefore appropriate education is important. In addition, proper staff training in the office is necessary. Immunizations are indispensable part of IPAC as they reduce number of dental health care providers susceptible to infectious diseases and minimize chance of transmission of infection to other staff and patients. Ideally, all DHCP should be immunized against MMR, Varicella, hep B, DiTePer and Polio. With emergence of Covid-19 virus this vaccine should also be considered. As prevention is the key, all effort should be taken to prevent any kind of exposure in dental office. Even though, most common exposure is through needle puncture and cuts, contact of mucous membranes of mouth, nose or eyes or contact with non-intact skin (abrasions, eczema, chapped hands) are also ways of possible path of infection. Occupational health and Safety Requirements prohibit eating and drink-

Figure 2. Donning and doffing PPE (personal protective equipment)
Slika 2. Redosled oblačenja i skidanja lične zaštitne opreme (LZO)

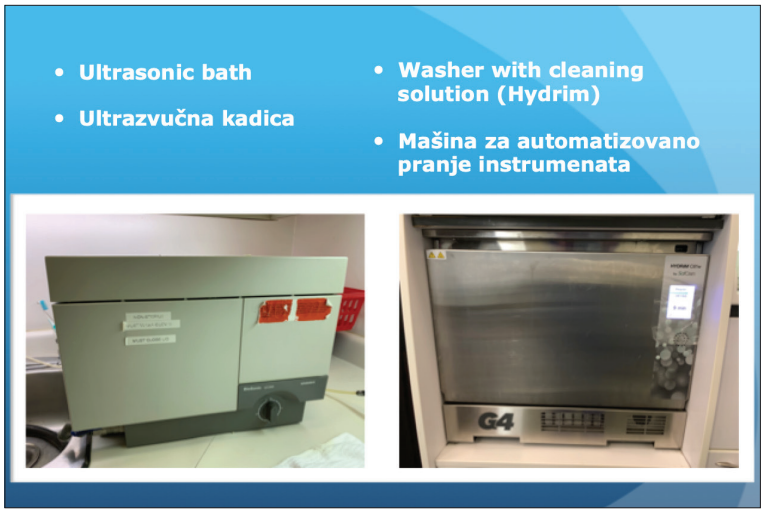

Figure 3. Ultrasonic bath and washer with cleaning solution (Hydrim)
Slika 3. Ultrazvučna kadica i mašina za pranje instrumenata (Hydrim)

ing in non-designated areas. Every employer has general duty to establish written procedures for the health and safety of employees.

Personal protective equipment (PPE) is worn to shield the exposed tissues of dental health care providers from exposure to potentially infectious material. Primary barriers include masks, gloves, protective eyewear and protective clothing. With emergence of Covid 19 PPE has improved with more layers of protection (shields, gowns, surgical cap, level 3, KN 95 or N95 masks).

Important consideration of PPE includes proper donning and doffing since the outside of PPE is contaminated after performing clinical work (Figure 2). Correct removal of contaminated gloves includes grasping the outside of one glove at the wrist without touching the bare skin. Then peeling the glove away, pulling it from inside out. The next step is to hold the glove that was just removed in the still gloved hand and to peel the second glove by putting the fingers inside the glove at the top of the wrist. Last step is to turn the second glove inside out while pulling away from body and leaving the first glove inside the second. Removed gloves should be disposed safely and not reused. Hands should always be washed after removing gloves and before touching any objects or surfaces.

Applying the principles of cleaning, disinfecting, sterilizing and storing dental instruments

All instruments must be properly cleaned, rinsed and dried prior to either disinfection or sterilization. Cleaning means removing debris (organic and inorganic matter) either by scrubbing with a surfactant, detergent and water, or by automated process (ultrasonic cleaner or washer with cleaning solution). After cleaning all instruments should be rinsed with water to remove detergent and visually inspected. The goal of this step is to safely process reusable patient care items (dental instruments, handpieces, devices and equipment) to:

1. Prevent transmission of microorganisms
2. Minimize damage to patient care items
3. Safe handling of chemical disinfectants

Patient care items are categorized into:

- Critical (Surgical instruments and surgical burs, implantable devices, periodontal instruments)
- Semi-critical (Mouth mirrors, reusable impression trays, X ray film holders)
- Non-critical (Radiograph head/cone, blood pressure cuff, safety glasses, pulse oximeter)
- Disposable items that cannot be safely and reliably sterilized.

Instrument sterilization requires multiple steps. All instruments must be processed in the area of dental office designed for it. The instrument processing area should have clear separation of clean and dirty areas with separate sections for receiving, cleaning, decontamination, preparation and packaging, sterilization, drying, cooling and storage.

After removing contaminated instruments from the operatory, a thorough rinsing with water is done and then they are either manually cleaned with detergent and brush or automatically processed in ultrasonic bath or Hydrim washer with cleaning solutions (Figure 3). After 15-30 min instruments are again thoroughly rinsed and dried prior to sterilization. Sterilization can be using dry heat, steam and chemicals.

Most dental offices in Canada use steam sterilizers such as STATIM and conventional autoclave (Figure 4). STATIM provides sterilization and dryness at speeds faster than conventional chambered autoclaves. Using only a small amount of water for each cycle, the STATIM heats and

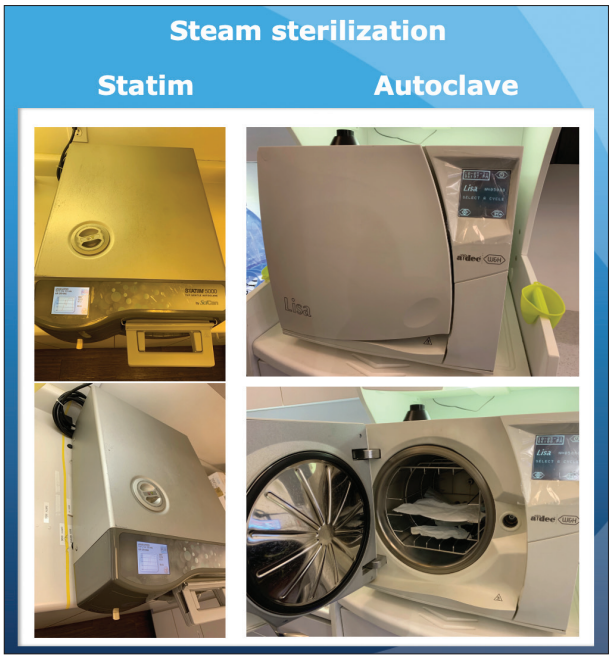

Figure 4. Steam sterilization: Statim and Autoclave
Slika 4. Sterilizacija vlažnom toplotom: Statim i Autoklav

Figure 5. Dry sterilization
Slika 5. Sterilizacija suvom toplotom

STERILIZER STERILIZATOR	TEMPERATURE TEMPERATURA	PRESSURE PRITISAK	TIME VREME
STEAM AUTOCLAVE AUTOKLAV	121 C (250 F)	15psi	15min
Unwrapped items Neupakovani instrumenti	132 C (270 F)	30psi	3min
Lightly wrapped items Lako upakovani instrumenti	132 C (270 F)	30psi	8min
Wrapped items Upakovani instrumenti	132 C (270 F)	30psi	10min
Dry heat wrapped items Suva toplota/upakovani instrumenti	170 C (340 F) 160 C (340 F) 150 C (300F) 140 C (285F) 121 C (250F)		60 min 120min 150min 180min 12hrs
Dry heat (rapid flow) unwrapped items Suva toplota/neupakovani instrumenti	190 C (375F)		6min
Dry heat (rapid flow) wrapped items Suva toplota/upakovani instrumenti	190 C (375 F)		12min
Chemical vapor Hemijske pare	132 C (270 F)	20-40 psi	20min
Ethylene oxide Etilen oksid	Ambient		8-10 hours

Figure 6. Temperature, pressure and time needed for different types of sterilization
Slika 6. Temperatura, pritisak i vreme potrebno za različite vrste sterilizacije

converts to steam in mere seconds. In Serbia, dry sterilizer is most commonly used in dental offices (Figure 5). Chemical sterilization is achieved by immersion of items in high level disinfectant, liquid germicide. It is used for semi-critical items that are heat sensitive. Most commonly used are 2% glutaraldehide and 7% hydrogen peroxide. It is important to follow manufacturer's instructions in regards to exposure time and how often it should be replaced.

Instruments can be sterilized unpackaged or packaged. Unpackaged sterilization sometimes called flash sterilization still includes all procedures of cleaning, decontamination, rinsing, drying prior to sterilization but instruments must be used immediately to prevent contamination. This would be in typical busy day in the office where instruments constantly interchange from dental operatories to sterilization area. Instruments can be packaged prior to sterilization in different situations: if sharp - not to be damaged, if not used immediately - to maintain sterility like surgical instruments.

Monitoring sterilization is essential part of sterilization process. It should be done consistently and systematically. There are different types of sterilization control procedures (physical, chemical, biological). Physical monitoring is performed in each cycle where the temperature, pressure and time of sterilization are recorded. Figure 6 shows temperature, pressure and time needed for different types of sterilization. Chemical monitoring is done by using tapes and strips that typically change the color after the targeted temperature is achieved. Both of these sterilization controls are confirming that physical conditions are reached during the specific sterilization cycles but only biological control confirms that sterilization has actually been completed. Biological testing typically includes the use of very resistant spores (*Baccilli*) either present in the form of strips or vials (Figure 7). One vial contains spores and medium that are physically separated with tiny glass. It is placed in sterilizer with other instruments and exposed to regular sterilization cycle. After the sterilization cycle is completed, the vial is taken out, crashed in the device to mix spores with growth medium and incubated for 1 day and monitored for up to 72 hours. If there is no growth recorded (no change of color) the sterilization was successful. Once sterilization is done instruments should be stored in dry place and protected from contamination.

Special consideration items such as handpieces and ultrasonic scaler tips, digital sensors and phosphor plate x-rays require modified cleaning and sterilizing procedures.

Handpieces should be wiped and then oiled manually or in special oiling machine and then sterilized. Ultrasonic tips must be sterilized. Digital sensors must be used at all time with protective barriers on and effectively avoid con-

Figure 7. Biological sterilization control
Slika 7. Biološka kontrola sterilizacije

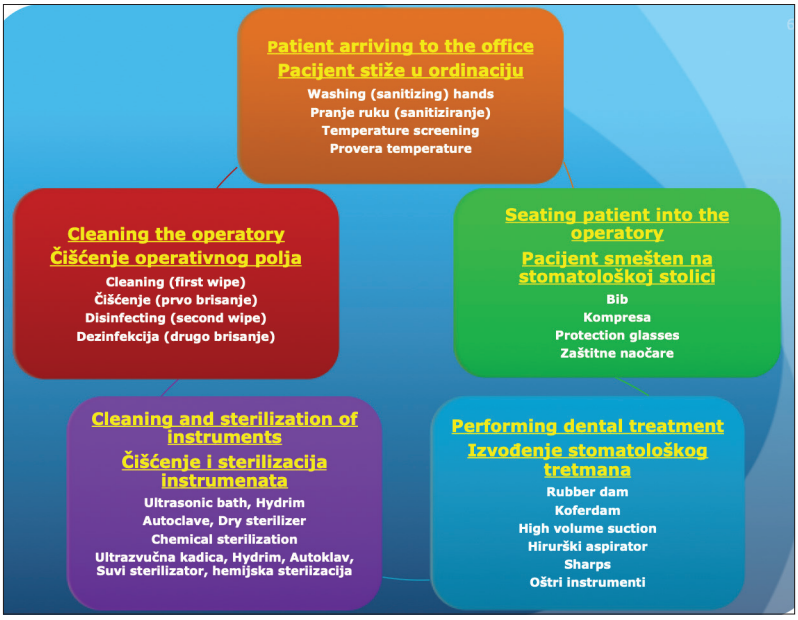

Figure 8. Graphical presentation how each patient should be treated, from entering the office until leaving, respecting all infection prevention and control protocols
Slika 8. Grafički prikaz postupaka sa svakim pacijentom od ulaska u ordinaciju do izlaska poštujući sve protokole prevencije i kontrole infekcije

tamination. If contaminated, manufacturer's instructions should be followed how to do properly cleaning and decontamination. Phosphor plate and regular x rays should have a protective barrier that must be carefully removed before processing without contamination.

Environmental cleaning

Generally speaking, environmental surfaces in the offices can be divided into clinical contact surfaces and housekeeping surfaces. Clinical contact surfaces are frequently touched with either gloves or contaminated instruments or are exposed to spatter and spray during dental procedures. Examples are: chair control and switches (unless foot pedals), drawer and faucet knobs, light handles and switches, countertops etc. These surfaces should be cleaned and disinfected between each patient and at the end of the day using low-level disinfectant. To facilitate this process all these areas must be kept clean. In addition, barriers should be used if difficult to wipe (for example, clear plastics) (intraoral camera). Housekeeping surfaces pose small risk of transmitting microorganisms; accordingly, they need only cleaning periodically with low level of disinfection.

It is important to mention that in the covid-19 era other housekeeping surfaces are more frequently wiped, like doorknobs, countertops in reception areas and Plexiglas barriers are used.

Care of the overall office setting

Water in waterlines must not be heated, only distilled water usually used to prevent buildups, before starting the day and between each patient waterlines should be flushed for 20-30 seconds to purge potentially contaminated air and water. At the end of the day or after single patient if surgery is performed suctions should be flushed with special solution that contains enzymes and clean the lines to prevent cross contamination.

Safe handling and waste disposal

Waste in the office can be biomedical and general office waste.

Biomedical can be anatomical or non-anatomical. Anatomical waste is mostly found in oral surgery or periodontal office and should be labeled and disposed separately. Non anatomical waste includes sharps and blood-soaked material. As previously mentioned, sharps should be properly disposed in puncture resistant containers while blood-soaked material should be labeled and disposed separately. Blood contaminated cotton rolls, gauze that is not fully soaked with water is considered general office waste as well as extracted teeth and does not need any special disposal.

As a summary of all given procedures, it is graphically presented how each patient should be treated, from the moment of entering the office until leaving, respecting all infection prevention and control protocols (Figure 8).

This manual is simple, detailed and easy to follow. For comparison we tried to find similar document in Serbia by Serbian Dental Association but there was none available. Asking a dentist from private practice we found out:

- There is no standardized protocol for infection prevention and control in dental offices.
- IPAC protocols are inconsistent, based on personal interpretation of basic knowledge of microbiology and epidemiology from undergraduate books and likely outdated.
- There are few documents available through continuing education (non-mandatory, on personal demand).

- More focus is given to post transmission/exposure protocols than on prevention of infection.
- There is no effective monitoring systems for IPAC protocols implementation in everyday practice.

CONCLUSION

Canadian IPAC protocols are detailed, uniform, accessible and easy to follow. Dental regulatory body in each country should be responsible to provide standard IPAC protocols to all practicing dentists. Regular updating as well as monitoring that all protocols are implemented is also important.

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Protokoli za prevenciju i kontrolu infekcije u stomatologiji – kanadske smernice

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KRATAK SADRŽAJ

Uvod Rizik od prenošenja zaraznih bolesti oduvek je bio sastavni deo stomatološke prakse. Lako prenosive respiratorne bolesti i bolesti koje se prenose krvlju podstakle su stomatološke zajednice da uspostave, procene, ažuriraju i nadgledaju protokole i strategije (smernice) za prevenciju i kontrolu infekcije.

Cilj ovog rada bio je da predstavi Kanadske standardne protokole i strategije za prevenciju i kontrolu infekcije u stomatološkim ordinacijama i uporedi ih sa sličnim smernicama koje su dostupne stomatolozima u Srbiji.

Metod U radu je predstavljen detaljan pregled najnovijih protokola i strategija za prevenciju i kontrolu infekcije koje je dala Stomatološka komora Britanske Kolumbije u Kanadi. Pored toga, razmotren je efekat najnovije pandemije kovida 19 na trenutne mere prevencije i kontrole infekcija u stomatološkim ordinacijama i buduće perspektive.

Zaključak Primena smernica za prevenciju i kontrolu infekcije je važan deo stomatološke prakse. Sa jedne strane, regulatorni organi imaju odgovornost da formiraju najnovije protokole i strategije za prevenciju i kontrolu infekcije i učine ih dostupnim stomatolozima, dok bi stomatolozi, sa druge strane, trebalo da usvoje te procedure i da ih na odgovarajući i dosledan način koriste u svakodnevnoj praksi.

Ključne reči: kontrola infekcije; stomatološki protokoli; prenošenje infekcije; kovid 19

UVOD

Rizik od prenošenja zaraznih bolesti oduvek je bio prisutan u stomatološkoj praksi. Bolesti koje se prenose krvlju, kao i respiratorne i druge bolesti, podstakle su stomatološke zajednice da formiraju, uspostave, unaprede i nadgledaju protokole i strategije (smernice) za prevenciju i kontrolu infekcije (PPKI). Stomatolozi bi trebalo da imaju na raspolaganju PPKI koje bi im omogućile da na bezbedan i efikasan način pravilno sprovode neophodne mere prevencije i kontrole infekcije. U Kanadi svaka provincija ima stomatološko regulatorno telo koje je odgovorno za uspostavljanje PPKI i njihovo korišćenje u stomatološkim ordinacijama [1, 2]. U Srbiji postoje dokumenti koji predstavljaju delove PPKI i dostupni su kao deo kontinuirane edukacije za stomatološke zdravstvene radnike u Srbiji, ali ne postoje detaljne i potpune Smernice za stomatološku zajednicu u Srbiji [3].

Da bi se uspešno osmislile i primenile efikasne mere PPKI važno je razumeti način prenošenja zaraznih bolesti u stomatološkim ordinacijama. Važna su tri ključna elementa: mikroorganizam, osetljivi domaćin i način prenošenja mikroorganizma (Slika 1) [4]. I pacijenti i stomatolozi su izloženi raznim bakterijama (npr. *Micobacterium tuberculosis*, stafilokok, streptokok) i virusima (npr. HBV, HCV, HIV, humani herpes virus, humani papiloma virus) koji se mogu naći u usnoj duplji. Prenos mikroorganizama može biti direktnim kontaktom (krv, pljuvačka), indirektnim kontaktom (instrument, oprema i radna površina), kapljično (kapljičnim kontaktom sa oralnom, nazalnom ili konjuktivalnom sluzokožom tokom kašljanja, kijanja ili razgovora) i aerosolom (mikročesticama koje mogu ostati u vazduhu tokom dužeg perioda u zatvorenom prostoru a nastaju tokom upotrebe turbine, zatim ultrazvučnog aparata za čišćenje zuba ili pustera za vazduh i vodu) [5].

Posmatrajući prevenciju i kontrolu infekcije istorijski, postojalo je nekoliko važnih događaja. Luj Paster je 1900-ih potvrdio postojanje mikroorganizama u vazduhu, a Lister je uveo asepsu [6, 7]. Tokom 1950-ih u stomatološku ordinaciju uvedeni su ultrazvučni aparati za čišćenje zuba i nasadni instrumenti, što je dovelo do upotrebe hirurškog aspiratora, koferdama, dobre ventilacije, preoperativnog ispiranja usta, maski i naočara, dezinfekcije, brisanja stolice i drugih površina između pacijenata i na kraju radnog dana [8]. Verovatno jedan od najvažnijih događaja u stomatologiji bio je 1980-ih sa pojavom HIV-a i povećanjem prevalence hepatitisa B i C, kada su uvedene univerzalne mere predostrožnosti, a sterilizacija instrumenata i upotreba rukavica postali standard [9]. Nedavno su zbog pandemije kovida 19 uvedena nova pravila i propisi o prevenciji i kontroli infekcije, i to najviše u pogledu lične zaštitne opreme za stomatološke zdravstvene radnike i evaluacije zdravstvenog stanja pacijenata pre posete ordinaciji [9]. Stoga PPKI treba smatrati promenljivim dokumentom koji bi trebalo stalno ažurirati.

Prema Kanadskom udruženju stomatologa postoji sedam PPKI principa [1]:

1. Procena pacijenta
2. Rutinske prakse
3. Korišćenje barijera
4. Primena principa čišćenja, dezinfekcije, sterilizacije i skladištenja stomatoloških instrumenata
5. Čišćenje operativnog prostora (stomatološke stolice i ostalih radnih površina)
6. Briga o celokupnoj ordinaciji
7. Bezbedno rukovanje i odlaganje otpada

Procena pacijenta

S vremena na vreme pacijenti koji se ne osećaju dobro dolaze u stomatološku ordinaciju. Njihovo stanje može biti povezano sa stomatološkim problemom koji imaju ili mogu imati neku respiratornu bolest (prehladu, grip, kovid 19). Važno je ispitati svakog pacijenta, otkriti razlog posete, odložiti pregled, ako treba, ili postupiti sa pacijentom tako

da svi zaposleni u stomatološkoj ordinaciji, kao i drugi pacijenti, budu zaštićeni od prenošenja infekcije.

Rutinske prakse

Kanadski zdravstveni sistem koristi termin „rutinske prakse" da opiše osnovne PPKI. Sličan termin je „standardne mere predostrožnosti" koji koristi CDC u Sjedinjenim Američkim Državama. Rutinska praksa je koncept zasnovan na tome da su svi pacijenti potencijalno infektivni, čak i ako ne pokazuju nikakve simptome, gde bi trebalo rutinski primenjivati PPKI u kontaktu sa krvlju, telesnim tečnostima, oralnom sluzokožom, oštećenom kožom i svim instrumentima koji mogu biti kontaminirani infektivnim agensima.

Rutinske prakse su zasnovane na četiri principa:

- Procena rizika
- Higijena ruku
- Upotreba lične zaštitne opreme (LZO)
- Bezbedno rukovanje i odlaganje oštrih predmeta i kontaminiranog otpada.

Procena rizika se mora uraditi pre svake interakcije sa pacijentom kako bi se utvrdilo koje su intervencije potrebne da bi se sprečilo prenošenje infekcije. Rizik zavisi od vrste stomatološke procedure i verovatnoće izlaganja krvi, telesnim tečnostima i sekretima, oštećenoj koži i sluzokoži. Mora se uzeti u obzir i zdravstveni status pacijenata, njegova saradnja, fizičko okruženje i imunološki status zaposlenih.

Higijena ruku je najvažnija mera za sprečavanje prenošenja mikroorganizama. Termin higijena ruku podrazumeva pranje ruku sapunom i dezinfekciju ruku dezinficijensom na bazi alkohola. Obe ove mere su podjednako efikasne osim ako ruke nisu vidno zaprljane. Za pravilno pranje ruku trebalo bi koristiti tečni običan ili antibakterijski sapun, naneti ga na vlažne ruke i koristiti minimalno 15–20 sekundi kako bi se temeljno očistili svi delovi ruku. Nakon ispiranja treba koristiti suvi papirni ubrus. Ruke treba oprati:

1. Pre stavljanja i posle skidanja rukavica
2. Pre i posle direktnog kontakta sa pacijentom
3. Nakon dodirivanja okoline, instrumenata, opreme...
4. Pre i posle jela i pića
5. Nakon obavljanja ličnih telesnih funkcija.

Dezinfekcija ruku treba da se vrši upotrebom sredstava za dezinfekciju koja sadrže 70–90% alkohola prema uputstvima proizvođača.

Korišćenje barijera

Kada govorimo o LZO, uglavnom mislimo na LZO za zaposlene u stomatološkoj ordinaciji, ali postoji i LZO za pacijenta u obliku zaštitnih barijera i tehnika za zaštitu pacijenata od potencijalno infektivnog materijala. Zaštitne naočare, komprese, koferdam itd. treba rutinski koristiti u svakodnevnoj praksi.

Mora se biti pažljiv u svakom trenutku kada se koriste oštri instrumenti, ali i tokom čišćenja i odlaganja kako bi se osiguralo da svi pacijenti budu zaštićeni od povreda. Svi oštri predmeti moraju biti odloženi na bezbedan način u kontejnere koji imaju čvste zidove otporne na probijanje iglom. Sprečavanje povreda koje uključuju oštre predmete je najvažnije, ali u slučajevima izlaganja infektivnim agensima (putem posekotine ili uboda) važno je da se takvom događaju na odgovarajući način pristupi i spovedu odgovarajuće mere.

Svi zaposleni u stomatološkoj ordinaciji uključujući i stomatologe verovatnije će se pridržavati PPKI ako ih budu dobro razumeli, stoga je važna odgovarajuća edukacija osoblja u ordinaciji. Imunizacija je neizostavni deo PPKI jer se tako smanjuje broj stomatoloških zdravstvenih radnika izloženih zaraznim bolestima. Takođe se i minimizira mogućnost prenošenja infekcije među osobljem kao i između osoblja i pacijenata. Idealno bi bilo da se svi zaposleni vakcinišu protiv MMR-a, varičela, hepatitisa B, DiTePer-a i dečije paralize. Sa pojavom kovida 19 i ovu vakcinu treba razmotriti.

Imajući na umu da je prevencija ključna, trebalo bi preduzeti sve napore kako bi se sprečila bilo kakva izloženost u stomatološkoj ordinaciji. Iako je najčešće izlaganje putem uboda iglom i posekotina, do infekcije može doći kontaktom infektivnih agenasa sa sluzokožom usta, nosa ili očiju ili kontaktom sa oštećenom kožom (abrazije, ekcem, ispucale ruke). Zahtevi za zdravlje i bezbednost na radu zabranjuju jelo i piće u neodređenim prostorima. Svaki poslodavac ima dužnost da obezbedi pisane instrukcije i uputstva koje se odnose na očuvanje zdravlja i bezbednosti zaposlenih.

Lična zaštitna oprema (LZO) nosi se da zaštiti tkiva stomatoloških zdravstvenih radnika od izlaganja potencijalno zaraznom materijalu. Primarne barijere uključuju maske, rukavice, zaštitne naočare i zaštitnu odeću. Pojavom kovida 19 LZO je poboljšana sa više slojeva zaštite (štitovi, zaštitni ogrtači, hirurške kape, maske KN 95 ili N95).

Važno razmatranje LZO uključuje pravilno oblačenje i skidanje opreme pošto je spoljašnja strana LZO kontaminirana nakon obavljanja kliničkog rada (Slika 2). Pravilno skidanje kontaminiranih rukavica podrazumeva hvatanje spoljašnje strane jedne rukavice bez dodirivanja kože. Zatim njeno skidanje okrećući unutrašnju stranu spolja. Rukavica koja je upravo skinuta drži se u ruci na kojoj se još uvek nalazi druga rukavica. Druga rukavica se skida tako što se prst ruke bez rukavice postavi u nju u predelu ručnog zgloba, a njena unutrašnja strana okreće spolja, pri čemu prva rukavica ostaje unutar druge. Uklonjene rukavice treba bezbedno odložiti i ne koristiti ih ponovo. Ruke uvek treba oprati nakon skidanja rukavica i pre dodirivanja bilo kakvih predmeta ili površina.

Primena principa čišćenja, dezinfekcije, sterilizacije i skladištenja stomatoloških instrumenata

Svi instrumenti moraju biti propisno očišćeni, isprani i osušeni pre dezinfekcije ili sterilizacije. Čišćenjem se uklanjanju ostaci organskih i neorganskih materija bilo ribanjem površinski aktivnim sredstvom, deterdžentom i vodom, ili automatizovanim procesom (ultrazvučna kadica ili mašina za pranje sa rastvorom za čišćenje). Nakon čišćenja sve instrumente treba isprati vodom kako bi se

uklonio deterdžent i vizuelno pregledati. Kroz ove postupke, putem sprečavanja prenošenja mikroorganizama, zatim smanjenjem šansi za oštećenje instrumentata i drugih predmeta, kao i bezbednim rukovanjem hemijskim dezinfekcionim sredstvima, omogućava se sigurno korišćenje sredstava za višekratnu upotrebu, kao što su stomatološki instrumenti, nasadni instrumenti, uređaji i oprema.

Predmeti koji se koriste za stomatološki rad na pacijenatima su kategorisani u nekoliko grupa:

- Kritični instrumenti (hirurški instrumenti i boreri/svrdla), materijali za implantate, instrumenti za čišćenje zuba/skidanje kamenca)
- Polukritični (ogledala za usta, otisne kašike za višekratnu upotrebu, držači za rendgenske filmove)
- Nekritični (radiografska glava/konus, manžetna za krvni pritisak, zaštitne naočare, pulsni oksimetar)
- Predmeti za jednokratnu upotrebu koji se ne mogu bezbedno i pouzdano sterilisati.

Sterilizacija instrumenata zahteva više koraka. Svi instrumenti moraju biti obrađeni u za to predviđenom prostoru stomatološke ordinacije. Prostor za obradu instrumenata treba da ima jasno razdvojene čiste (sterilne) i zaprljane (kontaminirane) oblasti sa posebnim delovima za prijem, čišćenje, dekontaminaciju, pripremu i pakovanje, sterilizaciju, sušenje, hlađenje i skladištenje instrumenata.

Nakon uklanjanja kontaminiranih instrumenata iz ordinacije u kojoj je urađena stomatološka intervencija, oni se detaljno ispiraju vodom, a zatim se ili ručno čiste deterdžentom i četkom ili automatski obrađuju u ultrazvučnoj kadici ili Hidrim mašini za pranje sa rastvorima za čišćenje (Slika 3). Posle 15–30 min. instrumenti se ponovo dobro isperu i osuše pre sterilizacije. Sterilizacija može biti suvom toplotom, vlažnom toplotom ili pomoću hemijskih rastvora.

Većina stomatoloških ordinacija u Kanadi koristi sterilizaciju vlažnom toplotom kao što je STATIM i konvencionalni autoklav (Slika 4). STATIM obezbeđuje sterilizaciju i sušenje mnogo većom brzinom u poređenju sa konvencionalnim autoklavom sa komorama. Koristeći samo malu količinu vode za svaki ciklus, STATIM zagreva vodu i pretvara u paru za samo nekoliko sekundi. U Srbiji se najčešće koristi suvi sterilizator (Slika 5). Hemijska sterilizacija se postiže potapanjem predmeta u dezinfekciono sredstvo visoke efikasnosti, tzv. tečni germicid. Koristi se za polukritične predmete koji su osetljivi na toplotu. Najčešće se koristi 2% glutaraldehid i 7% vodonik-peroksid. Važno je pratiti uputstva proizvođača u vezi sa vremenom izlaganja i sa tim koliko često treba da se menja rastvor.

Instrumenti se mogu sterilisati neupakovani ili upakovani. Neupakovana sterilizacija koja se ponekad naziva brza sterilizacija i dalje uključuje sve postupke čišćenja, dekontaminacije, ispiranja i sušenja pre sterilizacije, ali se instrumenti moraju odmah koristiti da bi se sprečila kontaminacija. Ovo bi bila situacija u jednoj ordinaciji koja u toku jednog dana ima puno pacijenata i gde se instrumenti stalno menjaju od stomatološke ordinacije do prostora za sterilizaciju. Instrumenti se mogu upakovati pre sterilizacije u različitim situacijama: ako su oštri – da se ne oštete, ako se ne koriste odmah – da bi se održala sterilnost, kao i hirurški instrumenti.

Praćenje i kontrola sterilizacije je suštinski deo procesa sterilizacije i treba je sprovoditi dosledno i sistematski. Postoje različite vrste kontrole sterilizacije (fizičke, hemijske, biološke). Fizička kontrola sterilizacije se vrši u svakom ciklusu gde se beleže temperatura, pritisak i vreme sterilizacije. Slika 6 prikazuje temperaturu, pritisak i vreme potrebno za različite vrste sterilizacije. Hemijsko praćenje se vrši korišćenjem temperaturnih traka koje menjaju boju nakon što se postigne željena temperatura. Obe ove kontrole sterilizacije potvrđuju da su postignuti fizički uslovi tokom specifičnih ciklusa sterilizacije, ali samo biološka kontrola potvrđuje da je sterilizacija zaista postignuta i završena. Biološko testiranje obično uključuje upotrebu veoma otpornih bakterijskih spora (Baccilli) prisutnih u obliku traka ili bočica (Slika 7). Jedna bočica sadrži spore i medijum koji su fizički odvojeni sićušnim staklom. Ona se stavlja se u sterilizator sa drugim instrumentima i izlaže redovnom ciklusu sterilizacije. Nakon što je ciklus sterilizacije završen, bočica se vadi, polomi se pregradno staklo kako bi se spore pomešale sa medijumom za rast, ubaci se u specijalan uređaj, inkubira jedan dan i prati do 72 sata. Ako nema zabeleženog bakterijskog rasta (bez promene boje), sterilizacija je bila uspešna. Kada se sterilizacija završi, instrumente treba čuvati na suvom mestu i zaštititi od kontaminacije.

Nasadni instrumenti i nastavci za ultrazvučni aparat za skidanje kamenca zahtevaju posebne postupke sterilizacije. Takođe, digitalni senzori i rendgenske fosforne ploče zahtevaju modifikovane procedure čišćenja i sterilizacije. Nasadne instrumente treba obrisati, podmazati ručno ili u specijalnoj mašini za podmazivanje, a zatim sterilisati. Nastavci za ultrazvučni aparat za skidanje kamenca takođe moraju biti sterilisani. Digitalni senzori se moraju uvek koristiti sa zaštitnim barijerama i efikasno izbegavati kontaminacija. Ako ipak dođe do kontaminacije, treba se pridržavati uputstava proizvođača kako pravilno izvršiti čišćenje i dekontaminaciju. Fosforne ploče kao i konvencionalni rendgenski filmovi trebalo bi da imaju zaštitnu barijeru, koja se mora pažljivo ukloniti pre daljeg procesuiranja bez kontaminacije.

Čišćenje radnih površina u stomatološkim ordinacijama

Uopšteno govoreći, radne površine u stomatološkim ordinacijama mogu se podeliti na kliničke kontaktne površine i nekliničke kontaktne površine. Kliničke kontaktne površine se često dodiruju rukavicama ili kontaminiranim instrumentima ili su izložene prskanju i spreju tokom stomatoloških procedura. Primeri su: kontrola stolice i prekidači (osim nožnih pedala), ručice za fioke i slavine, ručke i prekidači za svetlo, radne ploče itd. Ove površine treba čistiti i dezinfikovati između svakog pacijenta i na kraju dana korišćenjem dezinfekcionog sredstva niskog nivoa. Da bi se ovaj proces olakšao, sve ove oblasti moraju biti čiste. Pored toga, trebalo bi koristiti barijere ako ih je teško obrisati (na primer, prozirna plastika) (intraoralna kamera). Nekontaktne površine imaju mali rizik od

prenošenja mikroorganizama. Shodno tome, potrebno ih je samo periodično očistiti slabijim dezinficijensom.

Važno je napomenuti da je tokom pandemije kovida 19 značajno poboljšana higijena i nekontaktnih površina, kao što su kvake na vratima, radne ploče na recepciji i barijere od pleksiglasa.

Briga o celokupnom stanju ordinacije

Voda u vodovodnim cevima se ne sme zagrevati. Može se koristiti samo destilovana voda, koja se obično koristi da bi se sprečilo nakupljanje kamenca. Na početku radnog dana i između svakog pacijenta trebalo bi isprati vodovodne cevi 20-30 sekundi kako bi se izbacili potencijalno kontaminirani vazduh i voda. Na kraju dana ili čak nakon urađene hirurške intervencije, vodovodne cevi treba isprati posebnim rastvorom koji sadrži enzime kako bi se sprečila unakrsna kontaminacija.

Bezbedno rukovanje i odlaganje otpada

Otpad u ordinaciji može biti biomedicinski i opšti.

Biomedicinski otpad može biti anatomski ili neanatomski. Anatomski otpad se uglavnom nalazi u specijalističkim ordinacijama oralne hirurgije ili parodontologije i treba ga posebno obeležiti i odlagati. Neanatomski otpad podrazumeva oštre predmete i materijal natopljen krvlju. Kao što je ranije pomenuto, oštre predmete bi trebalo pravilno odlagati u kontejnere otporne na proboj iglom, dok bi materijal natopljen krvlju trebalo posebno obeležiti i odložiti. Krvlju kontaminirane vaterolne, zatim gaza koja nije u potpunosti natopljena krvlju, kao i izvađeni zubi, smatraju se opštim otpadom i nije potrebno nikakvo posebno odlaganje.

Kao sažetak svih datih procedura, grafički je prikazano kako bi trebalo tretirati svakog pacijenta, od trenutka ulaska u ordinaciju do izlaska, poštujući sve PPKI (Slika 8).

Ovaj priručnik je jednostavan, detaljan i lak za praćenje. Poređenja radi, pokušali smo da pronađemo sličan dokument u Srbiji od strane Stomatološkog društva Srbije, ali ga nije bilo. Pitajući stomatologa iz privatne ordinacije saznali smo:

- Ne postoji standardizovan PPKI u stomatološkim ordinacijama.
- PPKI su nedosledni, zasnovani na ličnom tumačenju osnovnih znanja iz mikrobiologije i epidemiologije iz udžbenika sa osnovnih studija, koji su često zastareli.
- Postoje neki dokumenti dostupni kroz kontinuirano obrazovanje (neobavezno, na lični zahtev).
- Više pažnje posvećeno je protokolima nakon transmisije/izlaganja nego prevenciji infekcije.
- Nisu postavljeni sistemi za praćenje implementacije PPKI u svakodnevnoj praksi.

ZAKLJUČAK

Kanadski PPKI su detaljni, jednostavni, pristupačni i laki za praćenje. Stomatološko regulatorno telo u svakoj zemlji trebalo bi da bude odgovorno da obezbedi standardne PPKI svim stomatolozima. Takođe je važno redovno ažuriranje, kao i praćenje implementacije svih protokola.

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Mg and Si substituted hydroxyapatite: behaviour in simulated body fluid

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SUMMARY

Due to its similarity with biological apatite found in vertebrate hard tissues, calcium hydroxyapatite is one of the most investigated materials in bone tissue engineering. As the biological apatite is not stoichiometric, ion substituted hydroxyapatites attract much atention since they more closely mimic the composition of natural bone. Although there are many investigations of the influence of foreign ions on the structure and physico-chemical properties of ion-substituted hydroxyapatites, there is scarse information on their behaviour in different media.

In the present study, magnesium (Mg), that plays a key role in bone metabolism and silicon (Si), that is necessary for normal skeletal development, were used as ion substitutes. The behaviour of Mg and Si substituted hydroxyapatite in simulated body fluid was investigated by XRD, FTIR and SEM. Obtained results confirmed great potential of these substituted hydroxyapatites for biomedical applications.

Keywords: substituted hydroxyapatite; magnesium; silicon; SBF

INTRODUCTION

Since calcium phosphates (CP) constitute the main mineral component of the hard tissues of vertebrates, their synthetic analogues are the most commonly used materials in orthopedics and dentistry [1, 2, 3]. Specifically, the mineral phase of the bones and teeth is the basic calcium phosphate, which is being equalized with synthetic calcium hydroxyapatite (HA, $Ca_{10}(PO_4)_6(OH)_2$) [2]. HA exhibits excellent biocompatibility and bioactivity due to its similarity with inorganic phases of biomineralized tissues, making it the most studied CP [1–5]. It is used for numerous biomedical applications, mostly in bone tissue engineering, such as: bone scaffold, for restoration of bone and periodontal defects, as a coating on metal implants, drug delivery system and antibacterial agent.

Despite huge similarity, biological apatites differ from stoichiometric HA in several aspects, such as non-stoichiometry, small crystal sizes and poor crystallinity which are important factors associated with the relatively high solubility of biological apatites compared to stoichiometric HA [2]. Biological apatites are actually carbonated apatites containing also foreign ions, which can be incorporated in or adsorbed on the apatite crystal surface. Also, nucleation and growth of CP in biological systems occur in an environment rich in ions, which can affect the kinetics of crystallization, and further the relative stability of CP. Therefore, the study of ionic substitution in HA is significant for several reasons: a better understanding of the biomineralization processes, control of the properties of the precipitated phase, increase of the bioactivity of the material, and delivery of the ions for treatment of the diseased bone [2, 6].

Magnesium and silicon ions are good candidates for incorporation in the HA lattice due to their biological importance. As it is known, magnesium is an important trace element in bone and teeth, and its lack causes bone fragility [2, 7]. It plays a key role in bone metabolism, since it influences osteoblast and osteoclast activity, and thereby bone growth. Silicon has a metabolic role in the bone growth and has been reported as necessary trace element for normal skeletal development, especially in the initial phases of bone formation [3, 6, 8]. Besides, simultaneous Mg/SiO_4 substitution was proposed as a manner to obtain material similar to biological apatite [2]. Therefore, these two elements were chosen to substitute Ca^{2+}/PO_4^{3-} in the HA lattice and investigate their behavior after immersion into simulated body fluid.

MATERIALS AND METHODS

Synthesis of substituted hydroxyapatite

All chemicals used were purchased from Sigma Aldrich, Germany.

Mg- substituted HA was synthesized by adding $(NH_4)_2HPO_4$ solution dropwise to the solution of $Ca(NO_3)_2{\cdot}4H_2O$ and $Mg(NO_3)_2{\cdot}6H_2O$. The reaction mixture was heated at 100°C under reflux for 5 hours. During

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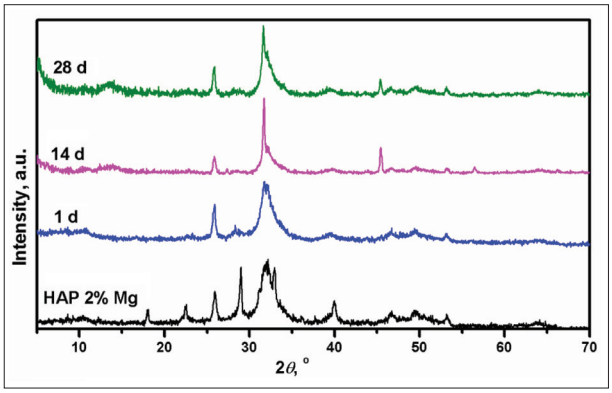

Figure 1. XRD patterns of HA doped with 2% Mg: the initial powder and powder obtained after immersion in corrected simulated body fluid for 1–28 days at 37°C.
Slika 1. XRD spektri HA dopiranog sa 2% Mg: početni prah i prahovi dobijeni posle potapanja u korigovani simulirani telesni fluid tokom 1–28 dana na 37°C.

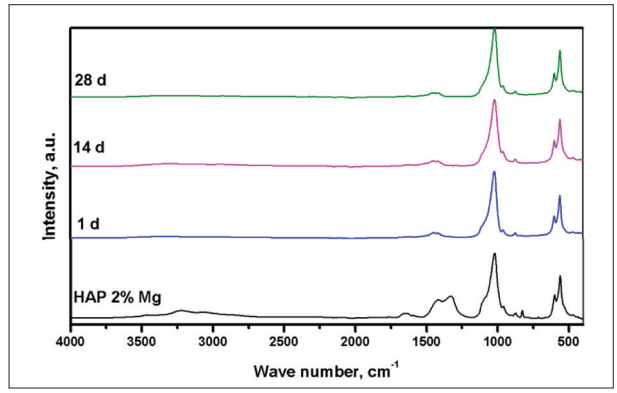

Figure 2. FTIR spectra of HA doped with 2% Mg: the initial powder and powder obtained after immersion in corrected simulated body fluid for 1–28 days at 37°C
Slika 2. FTIR spektri HA dopiranog sa 2% Mg: početni prah i prah i prahovi dobijeni posle potapanja u korigovani simulirani telesni fluid tokom 1–28 dana na 37°C

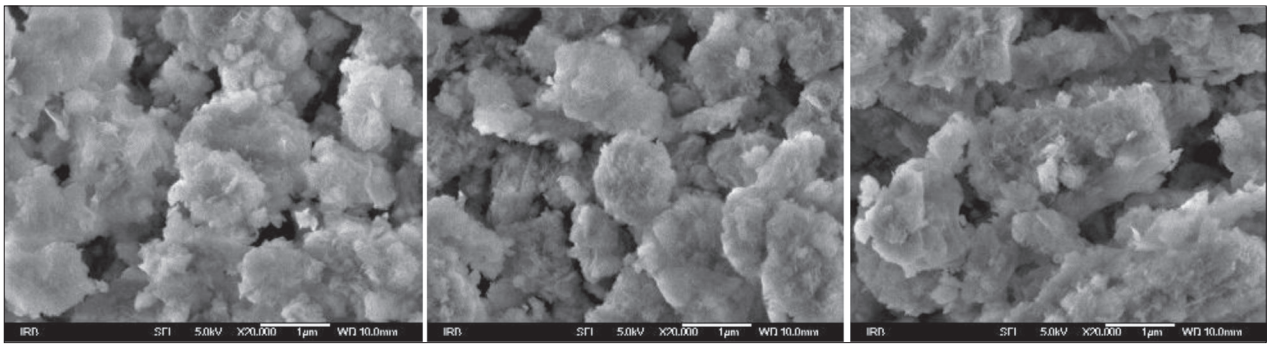

Figure 3. SEM images of HA doped with 2% Mg: a) the initial powder, b) powder after immersion in corrected simulated body fluid for 14 days, c) powder after immersion in corrected simulated body fluid for 28 days
Slika 3. SEM slike HA dopiranog sa 2% Mg: a) početni prah, b) prah i prahovi dobijeni nakon potapanja u korigovani simulirani telesni fluid tokom 14 dana, c) prah posle potapanja u korigovani simulirani telesni fluid tokom 28 dana

heating urea and urease were added and pH 8.8 was obtained. The product was filtered, washed with deionised water and ethanol and dried at 120°C.

Mg, Si-substituted HA was synthesized by adding solution containing $(NH_4)_2HPO_4$ and SiO_2 sol in a controled manner to the solution of $Ca(NO_3)_2{\cdot}4H_2O$ and $Mg(NO_3)_2{\cdot}6H_2O$. The SiO_2 sol was synthetized by the procedure described by Jokanović et al. [9]. The reaction mixture was heated at 100°C, under reflux for 5 hours. During heating urea urease was added and pH 7.9 was obtained. The product was filtered, washed with deionised water and ethanol and dried at 200 °C.

Mineralization in corrected simulated body fluid

Corrected simulated body fluid (c-SBF) was prepared by procedure described by Kokubo and Takadama [10]. As prepared c-SBF contains 142 mM Na^+, 5 mM K^+, 1.5 mM Mg^{2+}, 2.5 mM Ca^{2+}, 147.8 mM Cl^-, 4.2 mM HCO_3^-, 1.0 mM $_4^{2-}$ and 0.5 mM SO_4^{2-}. 10 mg of Mg- and Mg, Si- substituted HAP were added in 2 mL Eppendorf tubes along with 1 mL of c-SBF. The tubes were kept in thermostated water bath at 37°C for 28 days. The c-SBF was exchanged every day by centrifugation and decantation. The solid phase was filtered after 1, 14 and 28 days through 0.45 μm Millipore filter paper, washed 3 times with MilliQ water, one time with ethanol, and dried in nitrogen gas flow. The samples were kept in desiccator until further analysis.

Characterization methods

XRD patterns were recorded on Panalytical Aeris Research Edition in Bragg – Brentano geometry using CuKα radiation in angular scan range from 5° to 70° 2Θ using a step size of 0.02° 2Θ and a scan rate of 1° min^{-1}.

FTIR spectra of the samples were recorded on an FTIR spectrometer equipped with an attenuated total reflection module (Tensor I, Bruker, Ettlingen, Germany) in the range from 4000–400 cm^{-1}, with a resolution of 1 cm^{-1}. The presented spectra are the average of 16 scans.

The morphology of the solid phases was determined by a field emission scanning electron microscope (FE-SEM; JEOL JSM-7000F microscope). For SEM analysis a required amount of powder was placed on a sample holder covered with car-bon glue and the excess powder was removed by gentle nitrogen gas flow.

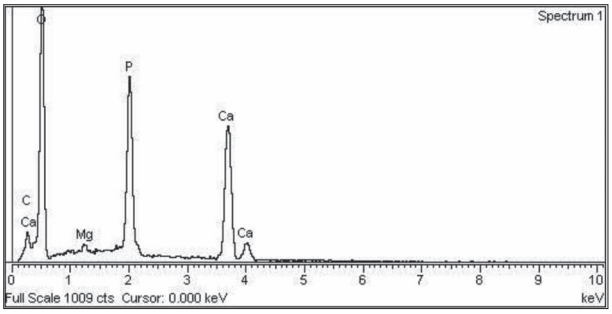

Figure 4. EDS spectrum of HA doped with 2% Mg
Slika 4. EDS spektar HA dopiranog sa 2% Mg

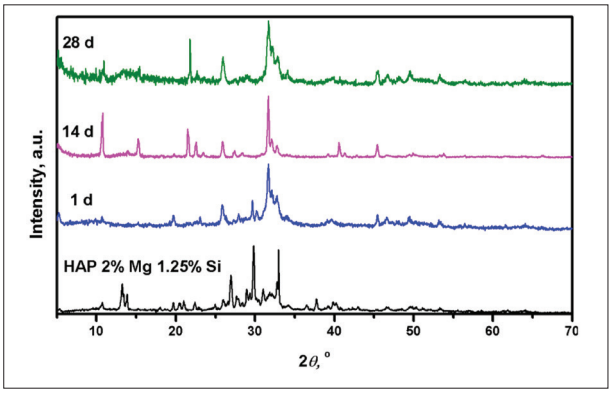

Figure 5. XRD patterns of HA doped with 2% Mg and 1.25% Si: the initial powder and powder obtained after immersion in corrected simulated body fluid for 1 - 28 days at 37°C.
Slika 5. XRD spektri HA dopiranog sa 2% Mg i 1,25% Si: početni prah i prahovi dobijeni posle potapanja u korigovani simulirani telesni fluid tokom 1–28 dana na 37°C.

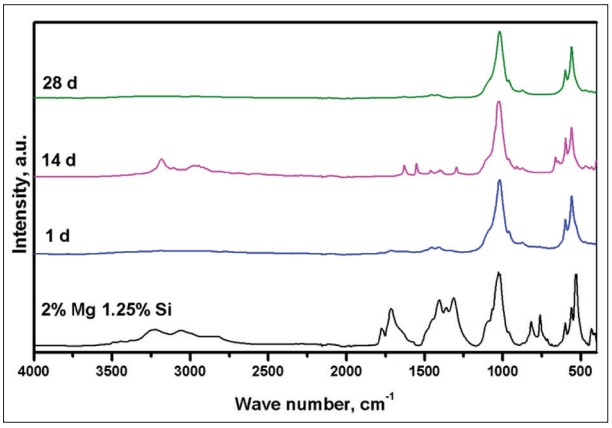

Figure 6. FTIR spectra of HA doped with 2% Mg and 1.25% Si: the initial powder and powder obtained after immersion in corrected simulated body fluid for 1–28 days at 37°C
Slika 6. FTIR spektri HA dopiranog sa 2% Mg i 1,25% Si: početni prah i prahovi dobijeni posle potapanja u korigovani simulirani telesni fluid tokom 1–28 dana na 37°C

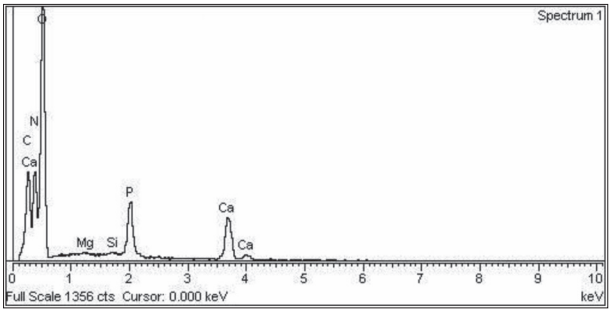

Figure 8. EDS spectrum of HA doped with 2% Mg and 1.25% Si
Slika 8. EDS spektar HA dopiranog sa 2% Mg i 1,25% Si

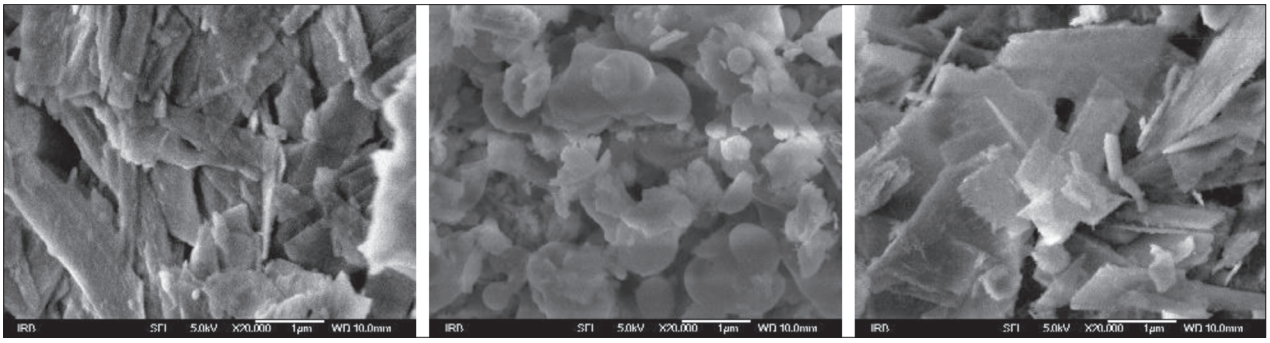

Figure 7. SEM images of HA doped with 2% Mg and 1.25% Si: a) the initial powder, b) powder after immersion in corrected simulated body fluid for 14 days, c) powder after immersion in corrected simulated body fluid for 28 days
Slika 7. SEM slike HA dopiranog sa 2% Mg i 1,25% Si: a) početni prah, b) prah posle potapanja u korigovani simulirani telesni fluid tokom 14 dana, c) prah posle potapanja u korigovani simulirani telesni fluid tokom 28 dana

RESULTS AND DISCUSSION

Mg-substituted HAP

XRD analysis revealed the peaks characteristic for HA (Figure 1); most intesive peaks can be observed at 2θ 25.90°, 29.01°, 31.19°, 32.17° and 32.95° corresponding to planes (002), (210), (211), and (112), respectively. In addition to HA peaks, a low intensity peak at 37.71° characteristic for $Mg(OH)_2$ was observed [11].

After immersion in SBF, peaks corresponding to (110), (111), (210), (112) and (310) HA reflections, as well as $Mg(OH)_2$ peak were not detected, already after 1 day (Figure 1). The low intensity maximum in 2θ range 12 -15° was observed after 14 days which was not observed in Mg-HA. In addition, low intensity peaks at around 45.5° and 56.5°, not present in the initial Mg-HA powder, were also observed.

FTIR spectra (Figure 2) showed vibrational bands of phosphate and hydroxyl groups characteristic for HA. The vibration of phosphate groups were observed at 1092, 1022, 961, 600, 561 and 472 cm^{-1} [12]. Besides, H_2O bands were observed at 3564 - 3000 cm^{-1} and 1633 cm^{-1}. CO_3^{2-} bands at 1426, 1321 and 873 cm^{-1} [11, 13], and $P_2O_7^{4-}$ band

at 715 and 828 cm^{-1}. The presence of water band in region 3564 – 3000 cm^{-1}, indicates the higher strength with which Mg-HA surfaces bind water molecules [14]. Two possible sites that Mg can occupy are the two crystallographic calcium sites. However, the majority of theoretical and experimental studies confirm that Mg preferentially occupies M(II) site [15].

FTIR spectra of the samples immersed in SBF did not contain water vibration band in region 3564 – 3000 cm^{-1} and band at 1633 cm^{-1}, as well as band at 828 cm^{-1} and $P_2O_7^{4-}$band at 715 cm^{-1} present in spectra of non-treated Mg-HA (Fig.2). Also, the intensity of CO_3^{2-} bands in region 1450 – 1330 cm^{-1} decreased.

SEM micrograph revealed formation of aggregated leaf-like crystals (Figure 3), while EDS spectra confirmed the presence of the magnesium in the material (Figure 4). The leaf like crystals appeared more developed after immersion in SBF for 14 and 28 days (Figure 3b and c).

Mg, Si- substituted HA

The XRD pattern (Figure 5) indicated formation of the mixture of HA with small amounts of monetite (β-Ca_3PO_4) and magnesium phosphate (MP, $Mg_7(PO_4)_2(OH)_8$). All the most intense HAP peaks were present in the diffraction pattern, while only the most intense peak and several low intensity peaks of β-Ca_3PO_4 were observed, as well as one peak of MP.

Upon immersion in SBF, already after 1st day, only peaks characteristic of HA were seen and a single peak of MP. After 14 days peaks were becoming narrower while after 28 days the broadening of the peaks was observed which can be a consequence of precipitation of additional material from SBF.

FTIR spectra (Figure 6) showed vibrational bands of phosphate groups at 1089, 1023, 962, 600, 560 and 532 cm^{-1}. The intensity of water band in region 3500 – 3000 cm^{-1} increased compared to Mg-HA. Fading of OH^- bands at about 3570 cm^{-1} and 630 cm^{-1} which are typically present in FTIR spectrum of HA was explained by reduction of the number of OH^- groups in order to maintain charge balance due to PO_4^{3-} ·substitution with ·SiO_4^{4-} [16]. This also confirms partial incorporation of SiO_4^{4-} into the HA [17]. In addition, vibrations of Si-O-Si group were detected at 1067 cm^{-1} and 820 cm^{-1} [18] and vibrations of Si-O group at 761 cm^{-1} and 432 cm^{-1} [17]. In FTIR spectra, after imersion in SBF, the water band in range 3500 – 3000 cm^{-1} and bands in range 1800 – 1500 cm^{-1}, 1500 – 1100 cm^{-1} and 810 – 650 cm^{-1} were faded.

SEM micrography revealed irregular, thin plate-like crystals (Figure 7a), while EDS spectra confirmed the presence of the magnesium and silicon in the material (Figure 8). After 14 days immersion in SBF there was no significant morphological changes (Figure 7b). However after 28 days, growth of thin leaf-like crystals on the sample surface was observed (Figure 7c).

CONCLUSION

Mg- and Si- substituted HA attract attention as biomimetic and bioactive hard tissue regeneration materials since they show beneficial biological effects. In order to determine their true potential for biomedical application their properties have to be carefully investigated. Despite the increasing number of studies of Mg- and Si- substituted HAs, some topics are rarely discussed although they are of huge importance for successful application of implant materials, such as the stability of material in model media.

In this study, behaviour of Mg- and Si-substituted HA upon immersion in simulated body fluid was investigated which mimics physiological conditions. The structure and composition of these materials were investigated by XRD, FTIR and SEM and the obtained results indicated that they have good potential for biomedical applications.

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Hidroksiapatit supstituisan magnezijumom i silicijumom: ponašanje u simuliranom telesnom fluidu

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KRATAK SADRŽAJ

Zbog svoje sličnosti sa biološkim apatitom koji se nalazi u tvrdim tkivima kičmenjaka, kalcijum-hidroksiapatit je jedan od najistraživanijih materijala u inženjerstvu koštanog tkiva. Pošto biološki apatit nije stehiometrijski, jonski supstituisani hidroksiapatiti privlače veliku pažnju jer više oponašaju sastav prirodne kosti. Iako postoje mnoga istraživanja uticaja stranih jona na strukturu i fizičko-hemijske osobine jonski supstituisanih hidroksiapatita, nema mnogo podataka o njihovom ponašanju u različitim medijumima. U ovom radu, magnezijum, koji igra ključnu ulogu u metabolizmu kostiju, i silicijum, koji je neophodan za normalan razvoj skeleta, korišćeni su kao joni supstituenti. Ponašanje Mg i Si supstituisanog hidroksiapatita u simuliranom telesnom fluidu je ispitivano pomoću XRD, FTIR i SEM. Dobijeni rezultati su potvrdili veliki potencijal ovih supstituisanih hidroksiapatita za biomedicinsku primenu.
Ključne reči: supstituisani hidroksiapatit; magnezijum; silicijum; SBF

UVOD

Pošto kalcijum-fosfati čine glavnu mineralnu komponentu tvrdih tkiva kičmenjaka, njihovi sintetički analozi su najčešće korišćeni materijali u ortopediji i stomatologiji [1, 2, 3]. Naime, mineralna faza kostiju i zuba je bazični kalcijum-fosfat, koji se izjednačava sa sintetičkim kalcijum-hidroksiapatitom (HA, $Ca_{10}(PO_4)_6(OH)_2$) [2]. HA ispoljava odličnu biokompatibilnost i bioaktivnost zbog svoje sličnosti sa neorganskim fazama biomineralizovanih tkiva, što ga čini najproučavanijim kalcijum-fosfatom [1–5]. Koristi se za brojne biomedicinske primene, uglavnom u inženjerstvu koštanog tkiva, kao što su: koštani nosač, za restauraciju koštanih i parodontalnih defekata, kao premaz na metalnim implantatima, sistem za isporuku lekova i antibakterijsko sredstvo.

Uprkos velikoj sličnosti, biološki apatiti se razlikuju od stehiometrijskog HA u nekoliko aspekata, kao što su nestehiometrija, male veličine kristala i loša kristaliničnost, što su važni faktori povezani sa relativno visokom rastvorljivošću bioloških apatita u poređenju sa stehiometrijskim HA [2]. Biološki apatiti su zapravo karbonizovani apatiti koji sadrže i strane jone, koji se mogu ugraditi ili adsorbovati na površini kristala apatita. Takođe, nukleacija i rast kalcijum-fosfata u biološkim sistemima dešavaju se u okruženju bogatom jonima, što može uticati na kinetiku kristalizacije i dalje na njihovu relativnu stabilnost. Stoga je proučavanje jonske supstitucije u HA značajno iz više razloga: boljeg razumevanja procesa biomineralizacije, kontrole svojstava precipitirane faze, povećanja bioaktivnosti materijala i isporuke jona za lečenje obolele kosti [2, 6].

Magnezijumovi i silicijumovi joni su dobri kandidati za ugradnju u rešetku HA zbog svog biološkog značaja. Kao što je poznato, magnezijum je važan element u tragovima u kostima i zubima, a njegov nedostatak uzrokuje krtost kostiju [2, 7]. Ima ključnu ulogu u metabolizmu kostiju, jer utiče na aktivnost osteoblasta i osteoklasta, a samim tim i na rast kostiju. Silicijum ima metaboličku ulogu u rastu kosti i navodi se kao neophodan element u tragovima za normalan razvoj skeleta, posebno u početnim fazama formiranja kostiju [3, 6, 8]. Pored toga, predložena je simultana supstitucija Mg/SiO_4 jona kao način dobijanja materijala sličnog biološkom apatitu [2]. Zbog toga su ova dva elementa izabrana da zamene Ca^{2+}/PO_4^{3-} u rešetki HA i da se istraži njihovo ponašanje nakon potapanja u simulirani telesni fluid.

MATERIJAL I METODE

Sinteza supstituisanog hidroksiapatita

Sve korišćene hemikalije kupljene su od Sigma Aldrich, Nemačka.

Mg-supstituisani HA je sintetisan dodavanjem rastvora $(NH_4)_2HPO_4$ kap po kap u rastvor $Ca(NO_3)_2{\cdot}4H_2O$ i $Mg(NO_3)_2{\cdot}6H_2O$. Reakciona smeša je zagrevana na 100°C pod refluksom, pet sati. Tokom zagrevanja dodavane su urea i ureaza i postignut je pH 8,8. Proizvod je filtriran, ispran dejonizovanom vodom i etanolom i osušen na 120°C.

Mg, Si supstituisani HA je sintetisan dodatkom rastvora koji sadrži $(NH_4)_2HPO_4$ i sol SiO_2 na kontrolisan način u rastvor $Ca(NO_3)_2{\cdot}4H_2O$ i $Mg(NO_3)_2{\cdot}6H_2O$. Sol SiO_2 je sintetizovan postupkom koji su opisali Jokanović i sar. [9]. Reakciona smeša je zagrevana na 100°C, pod refluksom, pet sati. Tokom zagrevanja dodavane su urea i ureaza i postignut je pH 7,9. Proizvod je filtriran, ispran dejonizovanom vodom i etanolom i osušen na 200°C.

Mineralizacija u simuliranom telesnom fluidu

Korigovani simulirani telesni fluid (c-SBF) pripremljen je postupkom koji su opisali Kokubo i Takadama [10]. Tako pripremljeni c-SBF sadrži 142 mM Na^+, 5 mM K^+, 1,5 mM Mg^{2+}, 2,5 mM Ca^{2+}, 147,8 mM Cl^-, 4,2 mM HCO_3^-, 1,0 mM HPO_4^{2-} i 0,5 mM SO_4^{2-}.

Deset mg Mg- i Mg, Si supstituisanog HAP-a je dodato u Ependorfovu epruvetu od 2 mL zajedno sa 1 mL c-SBF. Epruvete su držane u termostatiranom vodenom kupatilu na 37°C tokom

28 dana. C-SBF se menjao svakog dana centrifugiranjem i dekantacijom. Čvrsta faza je filtrirana posle 1, 14 i 28 dana kroz 0,45 μm filter papir Millipore, isprana tri puta vodom Milli Q, jednom sa etanolom, i osušena u struji azota. Uzorci su čuvani u eksikatoru do dalje analize.

Metode karakterizacije

XRD spektri su snimljeni na Panalytical Aeris Research Edition u Bragg–Brentano geometriji korišćenjem zračenja CuKa u opsegu ugaonog skeniranja 2θ od 5° do 70° koristeći veličinu koraka od 0,02° 2θ i brzinu skeniranja od 1° min^{-1}.

FTIR spektri uzoraka su snimljeni na FTIR spektrometru opremljenom modulom ometane ukupne refleksije (Tensor I, Bruker, Ettlingen, Nemačka) u opsegu od 4000–400 cm^{-1}, sa rezolucijom od 1 cm^{-1}. Prikazani spektri su prosek od 16 skeniranja.

Morfologija čvrstih faza određena je emisionim skenirajućim elektronskim mikroskopom (FE-SEM; JEOL JSM-7000F mikroskop). Za SEM analizu potrebna količina praha je stavljena na držač uzorka prekriven ugljeničnim lepkom i višak praha je uklonjen blagim protokom gasa azota.

REZULTATI I DISKUSIJA

Mg-supstituisani HAP

XRD analiza je otkrila pikove karakteristične za HA (Slika 1); najintenzivniji pikovi se mogu uočiti na 2Θ 25,90°, 29,01°, 31,19°, 32,17° i 32,95° koji odgovaraju ravnima (002), (210), (211) i (112), respektivno. Pored HA pikova, primećen je i pik niskog intenziteta na 37,71° karakterističan za $Mg(OH)_2$ [11].

Nakon potapanja u SBF, pikovi koji odgovaraju (110), (111), (210), (112) i (310) refleksijama HA, kao i $Mg(OH)_2$ pik nisu detektovani već nakon jednog dana (Slika 1). Maksimum niskog intenziteta u opsegu 2 Θ 12 -15° primećen je posle 14 dana, što nije primećeno kod izvornog Mg-HA. Pored toga, primećeni su i pikovi niskog intenziteta na oko 45,5° i 56,5°, koji nisu prisutni u početnom Mg-HA prahu.

FTIR spektri (Slika 2) pokazuju vibracione trake fosfatnih i hidroksilnih grupa karakterističnih za HA. Vibracije fosfatnih grupa su primećene na 1092, 1022, 961, 600, 561 i 472 cm^{-1} [12]. Osim toga, trake H_2O trake su primećene na 3564–3000 cm^{-1} i 1633 cm^{-1}; CO_3^{2-} trake na 1426, 1321 i 873 cm^{-1} [11, 13] i $P_2O_7^{4-}$trake na 715 i 828 cm^{-1}. Prisustvo vodenog pojasa u regionu 3564–3000 cm^{-1} ukazuje na veću snagu kojom površina Mg-HA vezuje molekule vode [14]. Dva moguća mesta koja Mg može zauzeti su dva kristalografska mesta kalcijuma. Međutim, većina teorijskih i eksperimentalnih studija potvrđuje da Mg prvenstveno zauzima M(II) mesto [15].

FTIR spektri uzoraka uronjenih u SBF nisu sadržali vibracioni opseg vode u oblasti 3564–3000 cm^{-1} i traku na 1633 cm^{-1}, kao ni traku na 828 cm^{-1} i $P_2O_7^{4-}$ traku na 715 cm^{-1} koja je prisutna u spektru netretiranog Mg-HA (Slika 2). Takođe, smanjen je intenzitet CO_3^{2-} traka u regionu 1450–1330 cm^{-1}.

SEM snimci su pokazali formiranje agregiranih kristala nalik na listove (Slika 3a), dok je EDS spektar potvrdio prisustvo magnezijuma u materijalu (Slika 4). Kristali nalik na listove su izgledali razvijeniji posle potapanja u SBF tokom 14 i 28 dana (slike 3b i 3c).

Mg, Si- supstituisani HA

XRD spektar (Slika 5) ukazuje na formiranje smeše HA sa malim količinama monetita (β-Ca_3PO_4) i magnezijum-fosfata (MP, $Mg_7(PO_4)_2(OH)_8$). Svi najintenzivniji pikovi HA su bili prisutni na difraktogramu, dok su uočeni samo najintenzivniji pik i nekoliko pikova niskog intenziteta koji pripadaju β-Ca_3PO_4, kao i jedan pik MP.

Nakon potapanja u SBF, već nakon prvog dana, uočeni su samo pikovi karakteristični za HA i jedan pik MP. Nakon 14 dana pikovi su postajali sve uži, dok je nakon 28 dana primećeno proširenje pikova, što može biti posledica taloženja dodatnog materijala iz SBF-a.

FTIR spektri (Slika 6) pokazali su vibracione trake fosfatnih grupa na 1089, 1023, 962, 600, 560 i 532 cm^{-1}. Intenzitet vodenog pojasa u regionu 3500–3000 cm^{-1} je povećan u poređenju sa Mg-HA. Iščezavanje OH- traka na oko 3570 cm^{-1} i 630 cm^{-1} koje su tipično prisutne u FTIR spektru HA objašnjeno je smanjenjem broja OH- grupa kako bi se održao balans naboja zbog zamene PO_4^{3-} SiO_4^{4-} jonima [16]. Ovo takođe potvrđuje delimičnu inkorporaciju SiO_4^{4-} u HA [17]. Pored toga, detektovane su vibracije grupe Si-O-Si na 1067 cm^{-1} i 820 cm^{-1} [18] i vibracije grupe Si-O na 761 cm^{-1} i 432 cm^{-1} [17]. U FTIR spektrima, nakon potapanja u SBF, vodeni pojas u opsegu 3500–3000 cm^{-1} i trake u opsegu 1800–1500 cm^{-1}, 1500–1100 cm^{-1} i 810–650 cm^{-1} iščezli su.

SEM mikrografijom su otkriveni nepravilni, tanki pločasti kristali (Slika 7a), dok je EDS spektar potvrdio prisustvo magnezijuma i silicijuma u materijalu (Slika 8). Posle 14 dana potapanja u SBF nije bilo značajnih morfoloških promena (Slika 7b). Međutim, nakon 28 dana primećen je rast tankih lisnatih kristala na površini uzorka (Slika 7c).

ZAKLJUČAK

Mg- i Si- supstituisani HA privlače pažnju kao biomimični i bioaktivni materijali za regeneraciju tvrdih tkiva jer pokazuju korisne biološke efekte. Da bi se utvrdio njihov pravi potencijal za biomedicinsku primenu, njihova svojstva moraju biti pažljivo istražena. Uprkos sve većem broju studija o Mg- i Si- supstituisanim HA, o nekim temama se retko diskutuje iako su od ogromnog značaja za uspešnu primenu implantnih materijala, kao što je stabilnost materijala u modelnim medijumima.

U ovoj radu ispitivano je ponašanje Mg- i Si-supstituisanog HA pri uranjanju u simulirani telesni fluid koji imitira fiziološke uslove. Struktura i sastav ovih materijala su ispitivani pomoću XRD, FTIR i SEM i dobijeni rezultati su pokazali da imaju dobar potencijal za biomedicinsku primenu.

Napomena

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CASE REPORT
PRIKAZ BOLESNIKA

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Oral manifestation of ulcerative colitis

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SUMMARY

Introduction Ulcerative colitis is an inflammatory bowel disease. Primary involvement is the colon. Changes in the oral cavity may occur as the part of extraintestinal manifestations of the disease. Most common are aphthous ulcers, angular cheilitis and pyostomatitis vegetans which is a specific marker of ulcerative colitis.

Case report This case describes a 53-year-old patient who developed oral lesions as the part of ulcerative colitis. The patient was without symptoms of ulcerative colitis at the time of reporting to the dentist. After a few days, ulcerative colitis activated.

Conclusion Changes that occur in the oral cavity may precede intestinal. It is very important that a dentist recognizes such changes and refers the patient to a gastroenterologist.

Keywords: inflammatory bowel disease; ulcerative colitis; oral manifestations

INTRODUCTION

Ulcerative colitis (UC) is an autoimmune disease and belongs to the group of diseases called inflammatory bowel disease. Inflammatory bowel disease (IBD) is an idiopathic, chronic unpredictable intestinal inflammation [1, 2]. The etiology of the disease is still unknown. It is thought to occur in genetically predisposed individuals, with a disrupted response of the mucosal immune system to the normal intestinal flora leading to intestinal inflammation [3, 4].

The disease is characterized by phases of exacerbation and remission, with symptoms of bloody diarrhea, abdominal pain, weight loss, and fever [1, 2, 5]. Extraintestinal manifestations of inflammatory bowel disease may be dermatological, rheumatological, ocular, hepatobiliary, urological, as well as thromboembolic complications, cardiopulmonary and oral [1, 2, 5].

Oral manifestations of ulcerative colitis are not as characteristic and striking as oral manifestations of Crohn's disease. They occur in 8% of patients. The most common can be seen: aphthous stomatitis and pyostomatitis vegetans (PV) [3–6], superficial hemorrhagic ulcers and angular cheilitis [5, 6, 7]. In addition to the above, the presence of halitosis, coated tongue, taste changes, sour taste, xerostomia and gingivitis and periodontitis was found in patients with UC [7, 8]. The occurrence of erosive temporo-mandibular joint disease, which occurs as part of spondyloarthropathy associated with ulcerative colitis, has also been reported [9]. Manifestations of UC in the mouth are related to the severity of the disease. The more severe form of the disease leads to a higher prevalence of oral ulcers, coated tongue and halitosis [7, 10]. Oral manifestations are unpleasant and painful and make it difficult for sick patients to eat.

Pyostomatitis vegetans is a chronic mucocutaneous ulcerative disorder, characterized by multiple white or yellow pustular or papillary changes on the erythematous surface of the labial mucosa, gingiva, and palate [11]. The rupture of these pustules causes small erosions and ulcerations that confluence, giving the appearance of a "snake track".

The aim of this paper is to present the case of a patient with Pyostomatitis vegetans (PV) oral manifestation of UC and the treatment procedure.

CASE REPORT

A 53-year-old patient came to the Dental Clinic of the Medical Faculty in Podgorica seeking treatment for mouth pain. Oral pain and lesions persisted for several days. The patient had a fever for one day. Regional lymph nodes were not enlarged. The medical history revealed that he has been diagnosed with UC 25 years ago. He was in remission for a year, and due to an allergy to sulfa- preparations and azathioprine, he was treated mainly with corticosteroids. At the time of his arrival at the clinic, he was without treatment. This was the patient's first experience with oral lesions since he was diagnosed with UC.

Clinical examination revealed erythema and inflammation with white to yellow small pustules on the mucosa of the lower lip and vermilion which was recognized as pyostomatitis vegetans (Figure 1). Under the local anesthesia (2% lidocaine), swabs were taken from the oral mucosa for microbiological analysis. The patient was prescribed local antiseptic therapy (0.2% chlorhexidine gluconate solution three times a day) and corticosteroid therapy (0.05% betamethasone ointment three times a day). After 7 days, the erosions clinically epithelialized and the

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Figure 1. Clinical appearance at the time of first presentation
Slika 1. Klinička slika tokom prve posete stomatologu

Figure 2. Clinical appearance at the second recall. There were no oral lesions.
Slika 2. Klinička slika pacijenta na kontrolnom pregledu. Nije bilo prisutnih oralnih lezija.

inflammation decreased. The patient continued with local therapy for another 7 days. The patient underwent a dental examination, including vitality tests. The panoramic X ray was taken as well. No pathological changes were found on the teeth, periodontal tissue and surrounding bone. Microbiological results were negative. However, on that occasion, the patient reported symptoms of UC, so he was referred to a gastroenterologist, who included systemic prednisolone therapy.

At the follow-up examination after 14 days, the clinical finding was normal without pathological changes (Figure 2). Local therapy was discontinued. Systemic prednisolone therapy was gradually reduced. After a month the patient was in remission and had no oral lesions.

DISCUSSION

Their anatomical and functional connection contributes to the manifestation of inflammatory bowel diseases in the oral cavity. Since the first signs of the disease appear in the oral cavity, recognizing the oral manifestations of inflammatory bowel disease is a challenge for dentists.

We presented a case of a patient who developed oral manifestations of UC. We found the presence of pyostomatitis vegetans in our patient's mouth. Oral lesions may occur before, coincide with, or after the onset of symptoms and lesions in the gastrointestinal tract [12]. In this case, the lesion appeared before the symptoms of UC. The severity of oral manifestations may indicate the degree of activity of the inflammatory process in the intestine [10]. Oral lesions can be treated with topical and systemic corticosteroids [13]. Topical administration of corticosteroids is sometimes not sufficient and, in this case, systemic administration is involved [5, 13]. Disappearance of the lesion and calming of the symptoms of the disease may result in the use of medium-high and high doses of corticosteroids. Abrupt dose reduction or cessation of treatment may exacerbate oral lesions and disease [14].

In the presented case, it was decided to start with the local application of corticosteroids, which was prescribed by a dentist. Systemic corticosteroid therapy was included by a gastroenterologist, after the onset of symptoms of the disease, which the patient took and gradually reduced as recommended. After 14 days, local therapy was discontinued.

CONCLUSION

In the presented case, the findings in the oral cavity were manifestations of ulcerative colitis. Good communication between a gastroenterologist and a dentist is necessary for the successful treatment of oral manifestations of ulcerative colitis.

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Oralna manifestacija ulceroznog kolitisa

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KRATAK SADRŽAJ

Uvod Ulcerozni kolitis je inflamatorna bolest creva. Primarno zahvata debelo crevo. Mogu se javiti i promene u usnoj šupljini u sklopu ekstraintestinalnih manifestacija bolesti. Najčešće se javljaju aftozne ulceracije, angularni heilitis i pyostomatitis vegetans koji predstavlja specifični marker aktivnosti ulceroznog kolitisa.

Prikaz slučaja U ovom radu opisan je slučaj 53-godišnjeg pacijenta koji je razvio oralne lezije u sklopu ulceroznog kolitisa. Pacijent je u trenutku javljanja stomatologu bio bez simptoma ulceroznog kolitisa. Nakon nekoliko dana došlo je do aktivacije ulceroznog kolitisa.

Zaključak Promene koje nastaju u usnoj šupljini mogu prethoditi intestinalnima. Veoma je važno da stomatolog prepozna takve promene i pacijenta uputi gastroenterologu.

Ključne reči: inflamatorna bolest creva; ulcerozni kolitis; oralne manifestacije

UVOD

Ulcerozni kolitis (UK) autoimuno je oboljenje i spada u grupu bolesti pod nazivom inflamatorne bolesti creva. Inflamatorna bolest creva idiopatska je, hronična nepredvidiva intestinalna inflamacija [1, 2]. Etiologija bolesti je još uvek nepoznata. Pretpostavlja se da nastaje kod genetski predisponiranih pojedinaca, pri čemu je poremećen odgovor imunološkog sistema sluzokože na normalnu crevnu floru, što dovodi do upale creva [3, 4].

Bolest karakterišu faze egzacerbacije i remisije, sa simptomima krvavih proliva, bola u stomaku, gubitka težine i povišene telesne temperature [1, 2, 5]. Ekstraintestinalne manifestacije inflamatornih bolesti creva mogu biti dermatološke, reumatološke, očne, hepatobilijarne, urološke, kao i tromboembolijske komplikacije, kardiopulmonalne i oralne [1, 2, 5]. Oralne manifestacije ulceroznog kolitisa nisu toliko karakteristične i upečatljive kao oralne manifestacije Kronove bolesti. Javljaju se kod 8% pacijenata. Najčešće se mogu videti: aftozni stomatitis i pyostomatitis vegetans [3–6], površinski hemoragični ulkusi i angularni heilitis [5, 6, 7]. Osim navedenih, utvrđena je i češća prisutnost halitoze, obloženog jezika, promene ukusa, kiselog ukusa, kserostomije, te gingivitisa i parodontitisa kod pacijenata sa UK [7, 8]. Zabeležena je i pojava erozivne temporomandibularne bolesti zglobova koja se javlja u sklopu spondiloartropatije povezane s ulceroznim kolitisom [9]. Manifestacije UK u ustima povezane su s težinom bolesti. Teži oblik bolesti dovodi do veće prevalencije oralnih ulceracija, obloženog jezika i halitoze [7, 10]. Oralne manifestacije su neprijatne i bolne i otežavaju ishranu obolelih pacijenata.

Pyostomatitis vegetans hronični je mukokutani ulcerativni poremećaj, kojeg karakterišu multiple bele ili žute pustulozne ili papilarne promene na eritematoznoj površini labijalne sluznice, gingive i nepca [11]. Rupturom tih pustula nastaju male erozije i ulceracije koje konfluiraju, pri čemu daju izgled „zmijskog traga“ („snail track“).

Cilj ovog rada je prikazati slučaj bolesnika s oralnom manifestacijom UK – poremećajem pyostomatitis vegetans i postupak lečenja.

PRIKAZ SLUČAJA

Pacijent star 53 godine došao je u Stomatološku kliniku Medicinskog fakulteta u Podgorici zbog bolova u ustima. Oralni bolovi i lezije perzistirali su nekoliko dana. Pacijent je imao povišenu temperaturu jedan dan. Regionalne limfne žlezde nisu bile uvećane. Anamnezom bolesnika ustanovljeno je da već 25 godina boluje od UK. Bio je u remisiji godinu dana, a zbog alergije na sulfopreparate i azatioprine, lečen je uglavnom kortikosteroidima. U periodu dolaska na Kliniku bio je bez terapije. Pacijentu je ovo bilo prvo iskustvo sa oralnom lezijom od kad mu je postavljena dijagnoza UK.

Kliničkim pregledom otkriveni su eritem i upala s belim do žutim malim pustulama na sluzokoži donje usne i vermilion, što je prepoznato kao pyostomatitis vegetans (Slika 1). U lokalnoj anesteziji (2% lidokain) uzeti su brisevi sa oralne sluznice za mikrobiološku analizu. Pacijentu je ordinirana lokalna antiseptička terapija (0,2% rastvor hlorheksidin-glukonata tri puta na dan) i kortikosteroidna terapija (0,05% betametazonska mast tri puta dnevno). Posle sedam dana klinički su erozije epitelizirane i upala se smanjila. Bolesnik je nastavio sa lokalnom terapijom još sedam dana. Urađen mu je pregled zuba, uključujući i testove vitaliteta. Analiziran je ortopan. Na zubima, parodoncijumu i okolnoj kosti nisu nađene nikakve patološke promene. Mikrobiološki rezultati bili su negativni. Međutim, tom prilikom bolesnik je prijavio simptome UK, pa je upućen gastroenterologu, koji mu je uključio sistemsku terapiju prednizolonom.

Na kontrolnom pregledu posle 14 dana klinički nalaz je bio normalan bez patoloških promena (Slika 2). Lokalna terapija je prekinuta. Sistemska terapija prednizolonom se postepeno smanjivala. Posle mesec pacijent je bio u remisiji i nije imao oralnih lezija.

DISKUSIJA

Manifestaciji zapaljenskih bolesti creva u usnoj duplji doprinosi njihova anatomska i funkcionalna povezanost. S obzirom na to da se prvi znakovi bolesti javljaju upravo u usnoj šupljini, prepoznavanje oralnih manifestacija upalnih bolesti creva predstavlja izazov za stomatologe.

Prikazali smo slučaj bolesnika koji je razvio oralne manifestacije UK. U njegovim ustima ustanovili smo prisustvo pyostomatitis vegetans. Oralne lezije se mogu pojaviti pre, za vreme ili posle pojave simptoma i lezija u gastrointestinalnom sistemu [12]. U ovom slučaju lezija se pojavila pre simptoma UK. Ozbiljnost oralnih manifestacia može ukazivati na stepen aktivnosti imflamatornog procesa u crevima [10]. Oralne lezije mogu

se lečiti primenom lokalnih i sistemskih kortikosteroida [13]. Lokalna primena kortikosteroida ponekad nije dovoljna i u tom slučaju se uključuje sistemska primena [5, 13]. Nestanak lezije i smirivanje simptoma bolesti mogu rezultirati primenom srednje visokih i visokih doza kortikosteroida. Naglo smanjenje doze ili prestanak lečenja može pogoršati oralnu leziju i bolest [14].

U prikazanom slučaju odlučeno je da se započne sa lokalnom primenom kortikosteroida, koju je ordinirao stomatolog. Sistemsku terapiju kortikosteroidom je uključio gastroenterolog, nakon pojave simptoma bolesti, a koju je pacijent uzimao i postepeno smanjivao po preporukama. Posle 14 dana lokalna terapija je prekinuta.

ZAKLJUČAK

U prikazanom slučaju nalazi u usnoj šupljini su bile manifestacije ulceroznog kolitisa. Za uspešno lečenje oralnih manifestacija kod ulceroznog kolitisa neophodna je dobra komunikacija između gastroenterologa i stomatologa.

Da li ste pažljivo čitali radove?

1. Primenom BRIX 3000:
   a) pacijenti su osećali bol i nelagodu
   b) pacijenti nisu osećali bol i nelagodu
   c) pacijenti su osećali bol, ali nije bilo nelagodnosti

2. Hypedontia je:
   a) povećan broj zuba u alveolarnom nastavku
   b) smanjen broj zuba u alveolarnom nastavku
   c) povećana veličina zuba u alveolarnom nastavku

3. Predstavljeni protokoli za prevenciju i kontrolu infekcije potiču iz:
   a) Srbije
   b) Kanade
   c) Francuske

4. Hemomehanička metoda uklanjanja karijesa je:
   a) atraumatska tehnika
   b) klasična tehnika
   c) postupak uklanjanja karijesa isključivo ručnim instrumentima

5. Pojava HIV-a je registrovana:
   a) 1970-ih
   b) 1980-ih
   c) 1990-ih

6. Joni Mg u hidroksiapatitu imaju ključnu ulogu u:
   a) metabolizmu kostiju
   b) normalnom razvoju skeleta
   c) kalcifikaciji kolagena

7. Oralne manifestacije ulceroznog kolitisa su opisane:
   a) kod deteta
   b) kod odraslog muškarca
   c) kod odrasle žene

8. Prilikom primene preparata BRIX 3000:
   a) značajno je povećana upotreba lokalnih anestetika
   b) značajno je smanjena upotreba lokalnih anestetika
   c) nije primetna razlika u primeni analgetika

9. Prekobrojni zubi se uglavnom:
   a) ekstrahuju
   b) ponekad ostavljaju i prate
   c) transplantiraju na mesto jako oštećenog zuba

10. Protokoli za prevenciju i kontrolu infekcije obezbeđuju:
    a) brzo sprovođenje neophodnih mera
    b) bezbednu i efikasnu terapijsku proceduru
    c) bezbednu primenu određenih materijala

11. Prema Kanadskom udruženju stomatologa postoji:
    a) 5 PPKI principa
    b) 6 PPKI principa
    c) 7 PPKI principa

12. Joni Si kod hidroksiapatita imaju ključnu ulogu u:
    a) metabolizmu kostiju
    b) normalnom razvoju skeleta
    c) kalcifikaciji kostiju

13. Specifični marker ulceroznog kolitisa je:
    a) pyostomatis vegetans
    b) prisustvo afti
    c) prisustvo hemoragičnih ulkusa

14. BRIX 3000 je gel koji deluje:
    a) na zdravom dentinu
    b) na zdravoj gleđi
    c) na nekrotičnom delu zubnog tkiva

15. Detaljne smernice za prevenciju i kontrolu infekcije u stomatološkim ordinacijama u Srbiji:
    a) postoje
    b) ne postoje
    c) nisu obavezne

16. Osnovni standardi „rutinske prakse“ u prevenciji i kontroli infekcije u Kanadi obuhvataju:
    a) četiri principa
    b) pet principa
    c) šest principa

17. Sintetički analozi kalcijum-fosfata su najčešće korišćeni materijali u:
    a) ortopediji
    b) stomatologiji
    c) ortopediji i stomatologiji

18. Aftozne ulceracije mogu biti znak postojanja ulceroznog kolitisa?
    a) Da
    b) Ne
    c) Skoro nikad

19. Bezbolan tretman posle primene BRIX 3000 je uočen kod:
    a) 14 pacijenata
    b) 4 pacijenta
    c) 2 pacijenta

20. Problem uklanjanja karijesa rotirajućim instrumentima je rešen na zadovoljavajući način?
    a) Da
    b) Ne
    c) Samo pri uklanjanu karijesa na donjim zubima

21. Lična zaštitna oprema zdravstvenih radnika uključuje:
    a) samo zaštitnu masku
    b) samo zaštitne rukavice
    c) maske, rukavice, naočare i odeću

22. Tri ključna elementa za razumevanje načina prenošenja zaraznih bolesti su:
    a) mikroorganizmi, njihov način prenošenja i domaćin
    b) mikroorganizmi, domaćin i oboljenje
    c) mikroorganizmi i domaćin

23. Hemomehanička metoda uklanjanja karijesa je:
    a) prihvatljiva metoda
    b) neprihvatljiva metoda
    c) prihvatljiva samo kod dece

24. Najproučavaniji kalcijum-fosfat je:
    a) hidroksiapatit
    b) kacijum-silikat
    c) magnezijum-silikat

25. BRIX 3000 je:
    a) sredstvo za hemomehaničko uklanjanje karijesa
    b) sredstvo za hemomehaničku instrumentaciju kanala
    c) sredstvo za opturaciju kanala

26. Prenos mikroorganizama direktnim kontaktom je:
    a) preko instrumenata
    b) preko kapljica
    c) preko aerosola u vazduhu

27. Problemi hiperdoncije su rešavani:
    a) u centru za stomatologiju u Foči
    b) na Stomatološkom odseku u Nišu
    c) na Stomatološkom fakultetu u Beogradu

28. Klasična ispitivanja uklanjanja karijesa su realizovana kod:
    a) 40 pacijenata
    b) 45 pacijenata
    c) 60 pacijenata

29. Neanatomski medicinski otpad uključuje:
    a) otpad u ordinacijama hirurgije i parodontologije
    b) oštre predmete i materijal natopljen krvlju
    c) samo endodontske instrumente

30. U rešavanju problema prekobrojnih zuba najvažnije je:
    a) mišljenje ortodonta
    b) multidisciplinarni pristup
    c) mišljenje oralnog hirurga

31. Prenos mikroorganizama putem kapljica je:
    a) preko opreme i radne površine
    b) putem kašlja
    c) preko mikročestica u vazduhu

32. Klinička ispitivanja hemomehaničkog uklanjanja karijesa su sprovedena kod:
    a) 40 pacijenata
    b) 30 pacijenata
    c) 20 pacijenata

33. Nedostatak Mg u kostima uzrokuje:
    a) bolju mineralizaciju kosti
    b) krtost kostiju
    c) ubrzava rast kosti

34. Hemomehaničkom metodom uklanjanje karijesa traje:
    a) duže
    b) kraće
    c) slično kao i kod klasične metode

35. Prenos mikroorganizama putem aerosola je:
    a) preko instrumenata
    b) putem kašljanja i kijanja
    c) preko turbine i testera

36. Problemi hiperdoncije se najčešće rešavaju:
    a) u dečjem uzrastu
    b) u pubertetu
    c) posle 25. godine

37. Rotirajućim instrumentima je karijes uklonjen kod:
    a) 20 pacijenata
    b) 30 pacijenata
    c) 40 pacijenata

38. Učestalost prekobrojnih zuba se kreće:
    a) 0,15–3,8%
    b) 0,15–2,8%
    c) 0,15–4,8%

39. Kod ulceroznog kolitisa se mogu javiti promene u usnoj duplji?
    a) Da
    b) Ne
    c) Skoro nikad

40. Klasičnom metodom uklanjanje karijesa traje:
    a) duže
    b) kraće
    c) slično kao i kod hemomehaničke metode

41. Ultrazvučni aparati za čišćenje zuba i nasadnih instrumenata uvedeni su:
    a) 1950-ih
    b) 1960-ih
    c) 1970-ih

42. Hemomehanička metoda uklanjanja karijesa je primenjena kod:
    a) 5 premolara
    b) 7 premolara
    c) 10 premolara

43. Atraumatski tretman uklanjanja karijesa je:
    a) adekvatna alternativa mehaničkom uklanjanju
    b) neadekvatna alternativa mehaničkom uklanjanju
    c) komplikovanija i neadekvatna metoda

44. Prekobrojni zubi normalnog izgleda se nazivaju:
    a) dentes supermi
    b) dentes accesoria
    c) distomolaria

45. Prosečno trajanje uklanjanja karijesa hemomehaničkom metodom kod kaviteta II klase je iznosilo:
    a) 5,8 minuta
    b) 6,9 minuta
    c) 9,9 minuta

46. Klinička provera preparata BRIX 3000 je realizovana na:
    a) Stomatološkom fakultetu u Beogradu
    b) Stomatološkom fakultetu u Sarajevu
    c) Stomatološkom fakultetu u Skoplju

47. Primena BRIX 3000 je realizovana kod:
    a) 11 molara
    b) 8 molara
    c) 6 molara

48. BRIX 3000 je gel koji sadrži:
    a) EDTA
    b) NaOcl
    c) papain

49. Meziodens je obično:
    a) manji od susednih zuba
    b) veći od susednih zuba
    c) identičan kao i ostali zubi

50. BRIX 3000 na zdravom dentinu:
    a) narušava čvrstu strukturu
    b) ne narušava čvrstu strukturu
    c) deluje samo na intertubularni dentin

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