

EVALUATION OF INCORPORATED FLUORIDE IN DENTINE AFTER APPLICATION OF THREE DIFFERENT FLUORIDE-RELEASING RESTORATIVE MATERIALS

EVALUACIJA INKORPORIRANOG FLUORIDA U DENTINU NAKON APLIKOVANJA TRI RAZLIČITA RESTAURACIONA MATERIJALA KOJI OSLOBODAJU FLUORID

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Abstract

The ability of the material to inhibit the phenomenon of secondary caries depends on several factors among them being forming an intimate connection between filling and the surface of the tooth as well as capability of the material to release caries protective agents as the fluoride happens to being the neighboring and surrounding dental structures.

The goal of the work is to determine the increase of the fluoride concentration in the dentine in a 6 weeks periodic case of permanent teeth being renovated by means of three different restorative materials, which according to the producer's recommendations are consisted of and release fluoride for a longer period of time. Two of them belong to the group of glass ionomer cements like Fuji II LC (GC Tokyo, Japan) resinous modified glass ionomer cements while the third one is a composite Tetric Ceram (Ivoclar, Vivadent). The examination was performed on extracted impacted third molars of patients the age being 30 to 40. The incorporated fluoride concentration has been determined by significant increase of spectrometer **Perkin Elmer 50** at the Faculty of Mathematics and Natural Science in Skopje.

The results of our examination revealed statistically significant increase of the fluoride concentration in the dentine after applying filling in all three tested materials. The analysis of the results regarding implementation of the fluoride in the dentin showed that the incorporated fluoride quantity in the dentin was highest after applying Chemfil superior and lowest in case of applying Fuji II LC.

Key words: secondary caries, fluoride, dental materials

Introduction

Secondary caries is undoubtedly the foremost reason for change of restorative filling. Secondary caries occurrence depends on several factors: the initial complete removal of caries substance, on the method of preparing

Kratak sadržaj

Sposobnost materijala da inhibira fenomen sekundarnog karijesa zavisi od više faktora, od kojih je jedan formiranje bliske veze između plombe i površine zuba kao i sposobnosti materijala da oslobađa karijes-protektivne agense.

Cilj rada je da se odredi porast koncentracije fluorida u dentinu tokom 6 nedelja u slučaju kada se permanentni zubi renoviraju pomoću 3 restorativna materijala, koji se po specifikaciji proizvođača sastoje od fluorida i oslobađaju ga tokom dužeg vremenskog perioda. Dva od njih pripadaju grupi glass ionomer cementa kao što je Fuji II LC (GC Tokyo, Japan), rezinoznom modifikovanom glass ionomer cementu, dok je treći kompozit Tetric Ceram (Ivoclar, Vivadent). Ispitivanje je izvedeno na ekstrahovanim uklještenim trećim molarima pacijenata starosti 30-40 godina. Koncentracija inkorporiranog fluorida određena je značajnim povećanjem na spektrometru **Perkin Elmer 50** na Fakultetu matematike i prirodnih nauka u Skoplju.

Rezultati našeg ispitivanja otkrili su statistički značajan porast koncentracije fluorida u dentinu po primeni punjenja sa sva tri testirana materijala. Analiza rezultata pokazuje da je količina inkorporiranog fluorida u dentinu bila najveća po primeni Chemfil superior a najniža u slučaju Fuji II LC.

Ključne reči: sekundarni karijes, fluorid, dentalni materijali

Uvod

Sekundarni karijes je, bez sumnje, najvažniji razlog za promenu restorativne plombe. Javljanje sekundarnog karijesa zavisi od nekoliko faktora: inicijalnog potpunog uklanjanja supstance karijesa, od metode pripreme sloja

enamel layer, on the oral hygiene, as well as on the capacity of material used, to bind the filling and the tooth and on its ability to release caries-protective agents such as fluoride.¹ The fluoride released from the restorative material is incorporated in the neighbouring teeth structures, thus making them more resistant to the activity by the cariogenic noxes.²⁻⁶ Research have shown that dentine, being a less mineralised tissue, is more susceptible to cariogenic influences of enamel. Dentine de-mineralises faster than enamel, recurrent caries occurs much quicker, yet re-mineralisation processes happen much faster than in enamel. Hence, the influence of fluoride-releasing materials in increasing dentine resistance is important, especially in preventing or postponing the spreading of recurrent caries towards pulp.⁷

It was this fact that encouraged us to start our research on quantity of incorporated fluoride in dentine, after application of three different fluoride-releasing materials, which according to recommendations by producers contained and released fluoride.

Materials and methods

The research was done on extracted and impacted third molars in patients of ages 30 – 40. After teeth extraction, we removed the soft tissue and separated the crown from the root section. Crowns were divided in three groups of 20 teeth each, according to the type of used material.

I. With the first group of 20 teeth, we examined fluoride uptake in dentine, after applying resin - modified glass ionomer cementum Fuji II LC (GC Tokyo Japan).

II. With the second group of 20 teeth, we examined fluoride uptake in dentine, after applying conventional glass ionomer cementum Chemfil superior (Dentsply Detray).

III. With the third group of teeth, we examined fluoride uptake in enamel and dentine, after applying composite Tetric Ceram (Ivoclar Vivadent) in combination with adhesive material Exite (Ivoclar, Vivadent). The procedure was identical to clinical *in vivo* conditions.

Crowns from each group were halved vertically, one half being the examined group and the other the control one. In all three groups of teeth, we prepared dentine cavities of 5 mm diameter, on the occusal surface/side.

gleđi, od oralne higijene, kao i od kapaciteta korišćenog materijala za vezivanje plombe i zuba i od njegove sposobnosti da oslobađa karijes-protektivne agense kao što je fluorid.¹ Fluorid oslobođen iz restorativnog materijala inkorporira se u strukturu susednih zuba, čineći ih otpornijim na aktivnost kariogenih noksi.²⁻⁶ Istraživanja pokazuju da je dentin, kao manje mineralizovano tkivo, podložniji kariogenim uticajima gleđi. Dentin se demineralizuje brže od gleđi, rekurentni karijes javlja se mnogo brže, ali se ipak procesi remineralizacije dešavaju mnogo brže nego u gleđi. Prema tome, uticaj fluorid-oslobađajućih materijala u povećanju rezistencije dentina vrlo je značajan, posebno u prevenciji ili odlaganju širenja rekurentnog karijesa prema pulpi.⁷

Ova nas je činjenica podstakla da počnemo istraživanje kvantiteta inkorporiranog fluorida u dentinu, nakon primene tri različita materijala koji oslobađaju fluorid (koji, po preporuci proizvođača, sadrže i oslobađaju fluorid).

Materijal i metode

Istraživanje je sprovedeno na izvađenim i uklještenim trećim molarima kod pacijenata starosti 30-40 godina. Nakon ekstrakcije zuba, uklonili smo meko tkivo i odvojili krunicu od korena. Krunice su podeljene u tri grupe, svaka sa 20 zuba, prema vrsti korišćenog materijala.

I. U prvoj grupi od 20 zuba ispitivali smo apsorpciju fluorida u dentinu nakon primene rezin-modifikovanog glass ionomer cementa Fuji II LC (GC Tokyo Japan).

II. U drugoj grupi od 20 zuba ispitivali smo apsorpciju fluorida u dentinu nakon primene konvencionalnog glass ionomer cementa Chemfil superior (Dentsply Detray).

III. U trećoj grupi od 20 zuba ispitivali smo apsorpciju fluorida u gleđi i dentinu nakon primene kompozita Tetric Ceram (Ivoclar, Vivadent) u kombinaciji sa adhezivnim materijalom Exite (Ivoclar, Vivadent). Procedura je bila identična kliničkim *in vivo* uslovima.

Krunice iz svake grupe bile su vertikalno podeljene na polovine – jedna polovina kao ispitivana grupa, druga kao kontrolna. U sve tri grupe zuba pripremili smo šupljine u dentinu od 5 mm u prečniku na okluzivnoj površini/strani.

Šupljine prve i druge grupe zuba tretirane su 20%-tnom poliakriličnom kiselinom, onda

The first and the second group of teeth' cavities were treated with 20% poly-acrylic acid, then rinsed, thoroughly dried and then applied filling. The third group of teeth, we had cavities corroded with 37% phosphoric acid for 10 sec. We rinsed thoroughly and dried, then applied the Excite adhesive, and had it treated under halogen light for 20 sec. On such a prepared cavity, we applied composite filling Tetric Ceram that got polymerised for 30 sec.

Each group of teeth as well as control ones, were kept in special containers with distilled water. After 6 weeks, the filling in the examined samples was removed. In both examined and control samples, we removed enamel and got dentine mass. The material was macerated in tiny pieces in a porcelain mortar. On an analytical (fourth-decimal) scale, we measured some of the dried crushed material and transferred it to a colbae and added 2-3 ml H₂O. The material was additionally treated with ultra-sound. We added 5ml flammable solution: HNO₃; HPCL₃; H₂SO₄ in ratio 40:1:2. The burning was done with a digestor, until the initially yellow solution turned white. We added few ml distilled water to the burned material and stirred. Through a sieve with filter-paper we poured some solution into a measuring colba. This was the mother solution, which was then diluted. Fluoride concentration in the diluted solution was quantitatively analysed spectrum – photo - metrically, by measuring the lantan-alyrsarine complexes at 600-620 nm wave length.⁸

Results

Table 1 provides percentage of fluoride uptake in dentine before and after application of restorative filling in each individual group respectively, namely Fuji II LC, Chemfil superior and Tetric Ceram. While measured average value of fluoride uptake before application was 0.021 – 0.023%, this value was considerably higher after application of filling. Thus, in teeth treated with Fuji II LC, the value measured 0.04%, the ones treated with Chemfil superior had 0.052%, whereas teeth treated with Tetric Ceram had 0.045% fluoride uptake in dentine.

Analyses made using Vilcox test of equivalent pairs for all three treated groups, showed value $p < 0.05$, which points to existence of a statistically significant difference in average percentage of fluoride in dentine before and after application of filling, i.e. there is a significant increase in fluoride uptake after application of filling.

isprane, potpuno prosušene, a onda je aplikovano punjenje. U trećoj grupi zuba imali smo šupljine korodirane 37%-tnom fosfornom kiselinom u trajanju od 10 sekundi. Izvedeno je potpuno ispiranje i sušenje, a onda je aplikovan Excite adheziv i izvršen je tretman pod halogenim svetlom tokom 20 sekundi. Na tako pripremljenu šupljinu aplikovali smo kompozitno punjenje Tetra Ceram koje je polimerizovano tokom 30 sekundi.

Sve grupe zuba kao i kontrolne, držane su u posebnim kontejnerima sa destilovanom vodom. Nakon 6 nedelja, punjenje u ispitivanim uzorcima uklonjeno je. I u ispitivanim i kontrolnim uzorcima uklonili smo gleđ i uzeli određeni volumen dentina. Materijal je maceriran u male komadiće u porcelanskoj posudi. Na analitičkoj (4-decimalnoj) vagi izmerili smo nešto od osušenog izmrvljenog materijala i prebacili ga u colbae i dodali 2-3 ml H₂O. Materijal je dodatno tretiran i ultrazvukom. Dodali smo 5 mm zapaljivog rastvora: HNO₃; HPCL₃; H₂SO₄ u odnosu 40:1:2. Spaljivanje je izvedeno digestorom, sve dok inicijalno žut rastvor nije postao beo. Dodali smo nekoliko ml destilovane vode spaljenom materijalu i promešali. Kroz sito sa filter-papirom usuli smo nešto rastvora u mernu colba. To je bio rastvor-majka koji je onda razblažen. Koncentracija fluorida u razblaženom rastvoru kvantitativno je analizirana spektrofotometrijski merenjem lantan-alizarin kompleksa na talasnoj dužini 600-620 nm.⁸

Rezultati

Tabela 1. prikazuje procenat apsorpcije fluorida u dentinu pre i nakon aplikacije restorativnog punjenja u svakoj od grupa redom, naime Fuji II LC, Chemfil superior i Tetric Ceram. Dok je izmerena prosečna vrednost apsorpcije fluorida pre aplikacije bila 0.021-0.023%, vrednost je znatno porasla nakon primene punjenja. Tako, u zubima tretiranim sa Fuji II LC izmerena vrednost bila je 0.04%; kod onih sa Chemfil superior 0.052%; i onih sa Tetric Ceram 0.045% apsorpcije fluorida u dentinu.

Analize izvedene Vilcox testom ekvivalentnih parova za sve tri tretirane grupe dale su vrednost $p < 0.05$, što ukazuje na postojanje statistički značajne razlike u prosečnom procentu fluorida u dentinu pre i nakon primene punjenja, tj. postoji signifikantan porast apsorpcije fluorida nakon primene punjenja.

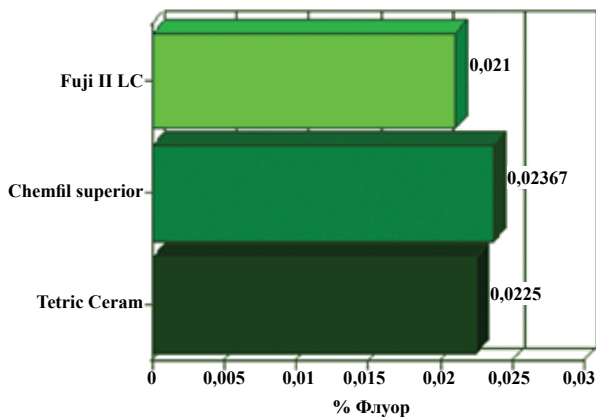
Table 1.

	Fluoride % before treatment	Fluoride % after treatment
Fuji II LC	0.021	0.04
Emfil superior	0.023	0.053
Tetric Ceram	0.025	0.045

Results of a statistical analysis of values before application of filling, have shown value $p < 0.05$, which meant there was a statistically significant difference in the % of fluoride uptake in dentine among the three restored materials, after application of filling (the highest being in Chemfil superior and lowest in Fuji II LC) (Table 1).

The analysis with Alfa test of the inter-group difference shows existence of a statistically significant difference ($p < 0.05$) in the % of fluoride uptake in dentine among samples treated with Fuji II LC and Tetric Ceram, compared to samples treated with Chemfil superior, after application of filling (higher in Chemfil superior). However, Alfa test showed absence of a statistically significant difference in fluoride uptake between Fuji II LC and Tetric Ceram ($p > 0.05$).

Diagrams 1 and 2 show fluoride uptake in dentine in the three treated groups, before and after application of restorative material.



Diag. 1. Fluoride uptake in dentine before application of restorative filling

Diag. 1. Apsorpcija fluorida u dentinu pre primene restorativnog punjenja

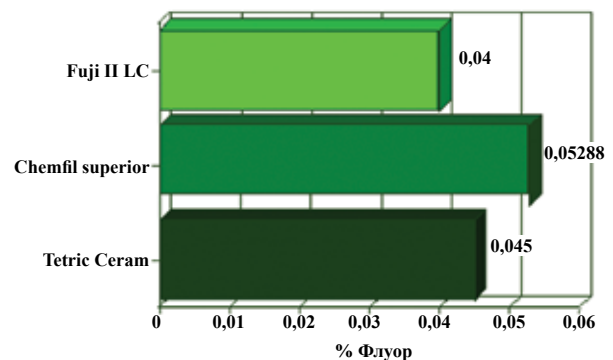
Tabela 1.

	Fluorid % pre tretmana	Fluorid % nakon tretmana
Fuji II LC	0.021	0.04
Emfil superior	0.023	0.053
Tetric Ceram	0.025	0.045

Rezultati statističke analize vrednosti pre primene punjenja daju vrednost $p < 0.05$, što znači da postoji statistički značajna razlika u procentu apsorpcije fluorida u dentinu za tri restauraciona materijala nakon primene punjenja (najveći sa Chemfil superior; najmanji sa Fuji II LC) (tabela 1).

Analiza razlika između grupa Alfa testom pokazuje statistički značajnu razliku ($p < 0.05$) u procentu apsorpcije fluorida u dentinu u uzorcima koji su tretirani sa Fuji II LC i Tetra Ceram, u poređenju sa uzorcima tretiranim sa Chemfil superior nakon primene punjenja (veći u Chemfil superior). Ipak, Alfa test demonstrira odsustvo statistički značajne razlike u apsorpciji fluorida između Fuji II LC i Tetra Ceram ($p > 0.05$).

Dijagrami 1 i 2 prikazuju apsorpciju fluorida u dentinu u tri tretirane grupe pre i nakon primene restorativnog materijala.



Diag. 2 Fluoride uptake in dentine after application of restorative filling

Diag. 2 Apsorpcija fluorida u dentinu po primeni restorativnog punjenja

Discussion

Research done so far, points to the fact that after application of restorative filling contain-

Diskusija

Dosada izvedena istraživanja ukazuju na činjenicu da nakon aplikovanja restorativnog

ing and releasing fluoride, a certain amount of released fluoride gets incorporated in enamel and dentine.^{4,10,11} This results in increased resistance to acids, of enamel edges and dentine that are in contact with fluoride releasing material. For this reason, application of fluoride-releasing restorative materials is important in reducing occurrence of secondary caries. These materials differ in their physical and chemical features, but also in the quantity of fluoride released.

Our research was done on three different restorative materials most commonly used in our everyday practice. Results of our research point to a significant increase in the % of fluoride uptake in dentine after application of all three restorative materials.

Thus, the percentage of fluoride uptake in dentine ranged from 0.021% before application of Fuji II LC, to 0.04% after application. Research with the other two restorative materials gave an average value of fluoride uptake in dentine of 0.023% before application, to 0.052% after application of Chemfil superior, and 0.025% uptake before to 0.045% after application of Tetric Ceram. These results are in line with results published by other authors.

The amount of acquired fluoride in sound enamel and dentin adjacent to glass ionomer restorations is substantial and may be appreciated for long periods. The quantity of incorporated fluoride in dentine is most probably proportionate to the released fluoride from the restorative material. According to Tam et al.⁷ research, the largest fluoride uptake is registered in teeth treated with conventional glass ionomer cement, while teeth treated with resin-modified GIC and composite show smaller values of incorporate fluoride. Micro-radiographic tests by Wesenberg and Einar¹², also point to significant incorporation of fluoride in dentine after application of glass ionomer cementum restoration.

Hotta et al. showed penetration of fluoride for GIC of approximately 20 μm in 30 days.¹³ Yamamoto et al. in their electron probe analysis showed that after treatment with a 2% NaF-solution, fluoride uptake in dentin was no higher than approximately 100 μm in 30 days.¹⁴ Tantbirojn and associates came to conclude that after a 30-day application of composite filling containing fluoride, there would be considerable increase in fluoride uptake in both enamel and dentine. The concentration of incorporated fluoride is highest in enamel/dentine layers that border with restoration. Deeper layers and

punjenja koje sadrži i oslobađa fluorid, određena količina oslobođenog fluorida biva ugrađena u gledi i dentin.^{4,10,11} To rezultuje povećanom rezistencijom na kiseline ivica gledi i dentina koji su u kontaktu sa materijalom koji oslobađa fluorid. Iz ovog razloga, aplikovanje restorativnog materijala koji oslobađa fluorid značajno je u redukovanju javljanja sekundarnog karijesa. Ovi se materijali razlikuju po svojim fizičkim i hemijskim karakteristikama ali i u količini oslobođenog fluorida.

Naše istraživanje urađeno je na tri restorativna materijala koji se često koriste u svakodnevnoj praksi. Rezultati ukazuju na značajno veći procenat apsorpcije fluorida u dentinu nakon aplikovanja svakog od ovih restorativnih materijala.

Tako se procenat apsorpcije fluorida u dentinu kretao od 0.021% pre primene Fuji II LC do 0.04% nakon primene. Ispitivanje preostala dva restorativna materijala daje prosečnu vrednost apsorpcije fluorida u dentinu od 0.023% pre primene, do 0.052% po primeni Chemfil superior i 0.025% apsorpcije pre do 0.045% posle primene Tetric Ceram. Rezultati se poklapaju sa onima koje su objavili drugi autori.

Količina apsorbovanog fluorida u tvrdoj gledi i dentinu u blizini glass ionomer restoracije značajna je i u dužim periodima može se evaluirati. Ova je količina verovatno proporcionalna oslobođenom fluoridu iz restorativnog materijala. Prema Tam i sar.⁷, najveća apsorpcija fluorida registruje se u zubima koji su tretirani konvencionalnim glass ionomer cementom, dok zubi tretirani resin-modifikovanim GIC i kompozitom pokazuju manje vrednosti inkorporiranog fluorida. Mikro-radiografski testovi Wesenberga i Einara¹² takođe ukazuju na značajno inkorporiranje fluorida u dentinu po primeni glass ionomer cementne restauracije.

Hotta et al. prikazuju penetraciju fluorida za GIC od oko 20 μm za 30 dana.¹³ Yamamoto et al. u svojoj analizi elektronskom sondom prikazuju da nakon tretmana 2% NaF-rastvorom, apsorpcija fluorida nije bila veća od oko 100 μm za 30 dana.¹⁴ Tantbirojn i sar. zaključuju da nakon 30-dnevne primene kompozitnog punjenja koje sadrži fluorid dolazi do znatnog povećanja apsorpcije fluorida u gledi i dentinu. Koncentracija inkorporiranog fluorida je najveća u slojevima gledi/dentina koji se graniče sa restauracijom. Dublji slojevi i oni koji nisu u kontaktu

those not in contact with the restorative material, contain considerably lower concentration of fluoride.¹⁵

Considering that in our research, the measurement of incorporated fluoride uptake was done in the entire dentine mass and not in individual layers in contact with filling, the values obtained are lower than those provided by above-mentioned authors.

The comparison of fluoride uptake in dentine among the three restorative materials used, had shown largest increase in teeth treated with Chemfil superior, whereas the lowest incorporated fluoride uptake in dentine was noticed after application of Fuji II LC.

Nonetheless, it is important to note the absence of significant difference in incorporated fluoride uptake, among teeth treated with Fuji II LC and Tetric Ceram. Greater fluoride uptake in dentine after application of Tetric Ceram (in comparison to the Fuji II LC) is most probably due to the applied corrosion technique. Teeth treated with Tetric Ceram to condition dentine, had 37% phosphoric acid used for 10 sec., whereas teeth treated with Fuji II LC had dentine conditioned with poly-acrylic acid. According to Tam and associates⁷, application of 10% phosphoric acid for dentine conditioning, considerably increases depth of fluoride incorporation both inter and intra tubularly. SEM research confirm presence of open or enlarged tubulae as well as demineralised inter-tubular dentine, on the surface corroded. Same authors claim additional application of hydrophilic primer could secure humidification of dentine surface, which assists transfer of fluoride ions into dentine.⁷ Shashikiran et al.¹⁶ in their *in vitro* research point to a significantly higher uptake of fluoride in hard dental tissues after application of fluoride – releasing composite, which proportionate to the types of bonding used.

The ability of a fluoride releasing material to affect *in vitro* secondary caries formation is illustrated by reduction in the occurrence of wall lesions along the tooth - restorative material interface. Different types of fluoride-releasing materials reduce occurrences of caries lesions from 40% to almost 80%. Darendeliler et al.¹⁷ point out to the significant decrease in both occurrences of caries lesions, and the depth of lesions, after application of three different types of fluoride-releasing materials.

Exterkate et al.,¹⁸ in their *in vitro* research point to the fact that the quantity of fluoride diffused through dentine is significantly smaller than the fluoride quantity released from the ma-

sa restauracionim materijalom sadrže znatno niže koncentracije fluorida.¹⁵

Imajući u vidu da je u našem istraživanju merenje inkorporiranog fluorida izvedeno u celokupnoj masi dentina a ne u pojedinačnim slojevima u kontaktu sa punjenjem, vrednosti koje smo dobili niže su od vrednosti koje beleže gore pomenuti autori.

Poređenje apsorpcije fluorida u dentinu za tri korišćena restauraciona materijala pokazuje najveće povećanje u zubima koji su tretirani sa Chemfil superior, dok je najmanja količina inkorporiranog apsorbovanog fluorida u dentinu zabeležena nakon primene Fuji II LC.

Ipak, značajno je primetiti odsustvo značajne razlike u inkorporiranom apsorbovanom fluoridu među zubima koji su tretirani sa Fuji II LC i Tetric Ceram. Veća apsorpcija fluorida u dentinu po primeni Tetric Ceram (u poređenju sa Fuji II LC) verovatno je posledica primenjene korozione tehnike. Zubi tretirani sa Tetric Ceram u kondicioniranju dentina tretirani su 10 sec. 37%-tnom fosfornom kiselinom, dok su zubi tretirani sa Fuji II LC imali dentin kondicioniran poliakrilnom kiselinom. Prema Tamu i sar.⁷, primena 10%-tne fosforne kiseline u kondicioniranju dentina značajno povećava dubinu inkorporiranja fluorida i inter- i intratubularno. SEM istraživanje potvrđuje prisustvo otvorenih ili uvećanih tubula kao i demineralizovanog intertubularnog dentina na korodiranoj površini. Neki autori saopštavaju da dodatna primena može da obezbedi ovlaživanje površine dentina, što pomaže transfer jona fluorida u dentin.⁷ Shashikiran i sar.¹⁶ u svom *in vitro* istraživanju ukazuju na znatno veću apsorpciju fluorida u tvrdim zubnim tkivima nakon primene fluorid-oslobađajućeg kompozita, proporcionalno tipu korišćenog vezivanja.

Sposobnost fluorid-oslobađajućeg materijala da utiče na *in vitro* sekundarni karijes ilustrovana je redukcijom incidencije lezija zida duž interfejsa zub-restauracioni materijal. Različite vrste fluorid-oslobađajućeg materijala smanjuju pojavu karijesa od 40% do skoro 80%. Darendeliler i sar.¹⁷ ističu značajno smanjenje i broja karijesnih lezija i njihove dubine nakon primene tri različite vrste fluorid-oslobađajućih materijala.

Exterkate i sar.¹⁸ u svom *in vitro* istraživanju ukazuju na činjenicu da je kvantitet fluorida u dentinu znatno manji od količine koja se oslobodi iz materijala. U istoj studiji oni pokazuju

terial. In the same study they show that fluoride released from the GIC and calcium and phosphate ions diffusing in from the pulpal side, may result in enhanced remineralisation of the demineralised tissue close to the restoration.

Our research shows that all three examined materials incorporate a significant amount of fluoride in dentine, within a period of six weeks.

It remains to see the effects of application of these materials in preventing secondary caries, and its inhibited spreading in deeper layers of dentine. Application of acid conditioners and dentine adhesives could provide solid closure on edges, easier fluoride incorporation in dentine, and higher resistance to secondary caries occurrence.

Conclusion

Upon basis of the achieved results we may expect carious activity especially in reduction of the secondary carious phenomena in case of all three renovating materials. But it remains to see the effects of application of these materials in preventing secondary caries, and its inhibited spreading in deeper layers of dentine. Application of acid conditioners and dentine adhesives could provide solid closure on edges, easier fluoride incorporation in dentine, and higher resistance to secondary caries occurrence.

da se fluorid oslobođen iz GIC i kalcijumski i fosfatni joni koji difundiraju sa strane pulpe mogu rezultovati boljom remineralizacijom demineralizovanog tkiva u blizini restauracije.

Naše istraživanje pokazuje da sva tri ispitivana materijala inkorporiraju značajnu količinu fluorida u dentin u periodu od 6 nedelja.

Preostaje da se prate efekti primene ovih materijala u prevenciji sekundarnog karijesa i inhibicije njegovog širenja u dublje slojeve dentina. Primena kiselih sredstava za kondicioniranje i dentinskih adheziva može da obezbedi bolje zatvaranje po ivicama, lakše inkorporiranje fluorida u dentin i veću otpornost na sekundarni karijes.

Zaključak

Na osnovu dobijenih rezultata možemo očekivati redukciju fenomena sekundarnog karijesa u slučaju sva tri renovaciona materijala. Međutim, ostaju da se utvrde efekti primene ovih materijala u prevenciji sekundarnog karijesa i inhibiciji njegovog širenja u dublje slojeve dentina. Primena kiselih sredstava za kondicioniranje i dentinskih adheziva može da obezbedi bolje zatvaranje po ivicama, lakše inkorporiranje fluorida u dentin i veću otpornost na sekundarni karijes.

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