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Ispitivanje uticaja okluzalne morfologije na penetraciju zalivača fisura i jamica

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The Impact of Occlusal Morphology on Fissure Sealant Penetration

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KRATAK SADRŽAJ

Uvod. *U savremenim istraživanjima u preventivnoj stomatologiji veoma su zastupljene studije koje se bave eksperimentalnim i kliničkim ispitivanjem sve većeg broja materijala koji se koriste za zalivanje fisura i jamica.*

Cilj. *Cilj ovog rada je bio da se proceni uticaj okluzalne morfologije zuba na mogućnost penetracije dve vrste zalivača fisura i jamica i registruje veličina zalivačem nepopunjenog prostora na dnu okluzalnog udubljenja skening elektronskim mikroskopom (SEM).*

Materijal i metod. *Uzorak je činilo 10 intaktnih sveže ekstrahovanih premolara i 10 trećih molara podeljenih u četiri grupe metodom slučajnog izbora. Kod pet premolara (I grupa) i 5 molara (II grupa) kao zalivač je korišćen glas jonomerni zalivač (Fuji VII), a u trećoj (5 premolara) i četvrtoj (5 molara) kompozitni zalivač (Helioseal F). Šest preseka svakog zuba je pripremano za posmatranje na skening elektronskom mikroskopu. Penetracija zalivača je posmatrana na uveličanju od 30X, a veličina zjapa na dnu fisure na uveličanju od 500X. Registrovana je penetracija zalivača u odnosu na ukupnu dubinu fisura i jamica, a veličina nepopunjenog prostora na dnu je izražavana najvećim dijametrom zjapa na dnu fisure. Rezultati su analizirani primenom χ^2 testa.*

Rezultati. *Statistička analiza je pokazala da ne postoji značajna razlika u penetraciji i veličini nepopunjenog prostora ni između ispitivanih materijala niti između ispitivanih grupa zuba. Prosečna dubina penetracije za glas jonomer iznosila je 83%, a za kompozitni zalivač 81%. Prosečni dijametar nepopunjenog prostora na dnu fisure za glas jonomerni i kompozitni zalivač iznosi 95 i 93 mikrometara, respektivno. Elementi fisurnog kompleksa označeni kao duboki su imali manju penetraciju zalivača i veći dijametar nepopunjenog prostora za oba ispitivana materijala($p<0.05$).*

Zaključak. *Na osnovu dobijenih rezultata može se zaključiti da je penetracija savremenih materijala koji se koriste za zalivanje fisura i jamica u značajnoj funkciji anatomije okluzalne površine zuba.*

Ključne reči: zalivanje jamica i fisura, okluzalna morfologija, glas jonomer cementi, kompoziti

SUMMARY

Introduction: *In contemporary preventive dentistry there are numerous experimental in vitro and clinical studies on the growing number of materials for sealing pits and fissures.*

Aim: *the aim of this study was to evaluate the impact of occlusal tooth morphology on penetrating abilities of two types of fissure sealants and measure the unfilled space at the bottom of occlusal groove using scanning electron microscopy (SEM).*

Materials and methods: *The sample consisted of 10 freshly extraced intact premolars and 10 molars randomly divided into 4 groups. In group I (5 premolars), and group II (5 molars) glass ionomer Fuji VII was used as fissure sealant, while in groups III (5 premolars) and IV (5 molars) resin-based sealant (Helioseal-F) was used. Six sections of each tooth were prepared for SEM. Sealant penetration was observed at 30x magnification and the unfilled space at the bottom of the groove at 500x. Sealant penetration in relation to the absolute depth of occlusal grooves was recorded and the unfilled space beneath the sealant was expressed through its greatest diameter. Rusulst were statistically analyzed using χ^2 test.*

Results: *There was no statistically significant difference in penetration ability and the unfilled space between tested materials or teeth groups. The average depth of penetration for glass ionomer was 83% and for resin-based sealant 81% of fissure depth. Mean diameters of the unfilled space beneath the sealants were 95 μm (glass ionomer) and 93 μm (resin-based sealant). Shallower penetration of both sealing materials was observed in deep pits and fissures with greater diameter of unfilled space ($p<0.05$).*

Conclusion: *Based on results of the present study it can be concluded that penetration of contemporary fissure sealants largely depends on occlusal tooth anatomy.*

Keywords: pit and fissure sealing, occlusal morphology, glass ionomer cements, composites

Primena preventivnih mera značajno smanjuje prevalencu karijesa na glatkim i aproksimalnim površinama zuba, dok karijes na okluzalnim površinama još uvek predstavlja problem. Klinička istraživanja su pokazala da su fisure i jamice mesta gde se najčešće javlja karijesna lezija(1). Osnovni razlog za to je anatomija, odnosno činjenica da se fizički i fiziološki razlikuju od glatkih površina zuba(2).

Pojava karijesa na okluzalnoj površini najčešće nastaje neposredno nakon nicanja zuba, za prosečno vreme od 24 meseca(3), jer se sazrevanje i poslednja faza mineralizacije kristala hidroksiapatita odvija u tom periodu.

Jedna od najefikasnijih profilaktičkih metoda u prevenciji karijesa je zalivanje fisura i jamica. Značajna promocija ove metode započinje šezdesetih godina prošlog veka kada Cueto i Buonocore predstavljaju proceduru zalivanja fisura čime, između ostalog, započinje i era adhezivne stomatologije(4). U narednim decenijama ona se samo razvija i usavršava i predstavlja centralnu temu mnogih eksperimentalnih i kliničkih studija u preventivnoj i restaurativnoj stomatologiji.

Američka Dentalna Asocijacija (ADA) 1983. g., prihvatila je primenu zalivača kao sigurnu i efikasnu profilaktičku meru koja treba da bude deo ukupnog preventivnog programa(5). Na taj način data je prednost neinvazivnim postupcima čija je osnovna karakteristika osiguranje efikasne zaštite fisura i jamica (6)

Dijagnostika statusa jamica i fisura je otežana jer klinički pregled uz pomoć stomatološke sonde i ogledalca ne omogućava uočavanje svih udubljenja na površini zuba. Mikroskopska ispitivanja su pokazala da okluzalne fisure koje klinički izgledaju plitko, povremeno imaju udubljenja koja se inspekcijom ne mogu detektovati, a koja su ispunjena debrisom i mikroorganizmima(7,8). Jedna od osnovnih karakteristika zalivača jamica i fisura koja determiniše njegove profilaktičke karakteristike je mogućnost penetracije u uzane i teško dostupne delove jamica i fisura.

Poslednjih godina kao materijali za zalivanje jamica i fisura se koriste kompoziti koji otpuštaju fluor, ali se ipak, nakon poboljšanja fizičko-mehaničkih osobina sve više koriste glas jonomerni materijali.

Cilj ove eksperimentalne studije bio je da se proceni uticaj okluzalne morfologije na mogućnost penetracije dve različite vrste zalivača fisura i jamica i registruje veličina zalivačem nepopunjenog prostora na dnu okluzalnog udubljenja primenom SEM.

Materijal i metod

Za ispitivanje odnosa zalivača i površine gledji, a u funkciji okluzalne morfologije je korišćeno 10 sveže ekstrahovanih intaktnih premolara i 10 intaktnih trećih molara. Zubi su ekstrahovani iz ortodontskih ili hirurških razloga i pre eksperimenta čuvani su u destilovanoj vodi na temperaturi od +4ºC, u istoj boci. Metodom slučajnog

Preventive measures significantly decrease the prevalence of caries on smooth and proximal tooth surfaces, while occlusal caries still remains a problem. Clinical studies have shown that a carious lesion most frequently occurs in pits and fissures (1). The main reason for that is anatomy and the fact that pits and fissures physically and physiologically differ from smooth tooth surfaces (2).

Occlusal caries develops most frequently immediately after tooth eruption, for the average period of 24 months (3), because maturation and the last phase of mineralization of hydroxyapatite crystals happen in that time.

One of the most efficient prophylactic measures in caries prevention is sealing pits and fissures. Important promotion of this method begins in the 1960'ties when Cueto and Buonocore introduced the procedure of fissure sealing and opened the era of adhesive dentistry (4). In the next decades, this method keeps developing and improving and becomes the central object of mane experimental and clinical studies in preventive and restorative dentistry.

In 1983. the American Dental Association (ADA) accepted the use of fissure sealants as safe and effective prophylactic measure as part of the whole preventive programme (5). In this way, non-invasive procedures for effective protection of pits and fissures are promoted in dentistry (6).

Diagnostic of pits and fissure status is difficult because clinical examination with dental probe and mirror does not ensure detecting all gaps on tooth surface. Microscopic studies have shown that occlusal fissures that appear shallow occasionally have gaps filled with debris and microorganisms and are impossible to be detected by inspection (7,8). One of the main characteristics of fissure sealants that determines their prophylactic nature is the ability to penetrate narrow and unreachable parts of pits and fissures.

In recent years, composites that release fluoride have been used as fissure sealants. After improvements in their physical and mechanical properties, glass ionomer cements are more frequently used.

The purpose of this experimental *in vitro* study was to evaluate the impact of occlusal morphology on penetrating ability of two different fissure sealants and to measure the unfilled space at the bottom of occlusal pits and fissures using scanning electron microscopy (SEM).

Materials and Methods

Ten intact premolars and 10 third molars freshly extracted from orthodontic of surgery reasons were used in the study. Teeth were stored in distilled water at +4ºC in one bottle prior to the experiment. Teeth were randomly divided in 4 groups of 5 teeth. Glass ionomer and resin-based sealants were placed on 5 premolars and 5 molars, each.

uzorka zubi su podeljeni u 4 grupe od po 5 zuba. Na po 5 premolara i po 5 molara postavljeni su glas jonomerni, odnosno kompozitni zalivači fisura.

U eksperimentu su korišćeni kompozitni zalivač fisura Helioseal-F (Ivoclar Vivadent, Liechtenstein), i glasjonomer za zalivanje fisura Fuji VII (GC, Japan). Materijali korišćeni u istraživanju postavljeni su na zube uz potpuno simuliranje kliničkih uslova aplikacije. Uklanjanje mekih naslaga sa okluzalne površine ispitivanih zuba izvršeno je pastom bez fluora i glicerina.

Za nagrizanje gledji kod primene kompozitnih zalivača korišćena je 37% ortofosforna kiselina u špricu, u obliku gela, 20 sekundi. Zatim su zubi ispirani u toku 15 sekundi i sušeni pod blagim pritiskom vazduha u toku 15 sekundi. Zalivač je aplikovan i svetlosno polimerizovan u toku 40 sekundi. Poliranje je u vlažnoj sredini izvršeno silikonskom gumicom.

Glas-jonomerni zalivač je postavljan na površinu zuba nakon kondicioniranja 10% poliakrilnom kiselinom (GC Cavity Conditioner, GC, Japan) u toku 10 sekundi. Nakon ispiranja od 15 sekundi i sušenja od 15 sekundi aplikovan je pripremljeni zalivač, a zatim i protektivni lak koji je polimerizovan 20 sekundi.

Do eksperimenta zubi su čuvani u destilovanoj vodi, na temperaturi od +4ºC.

Sedam dana nakon aplikacije zubi su pripremani za ispitivanje na SEM. Zubi su sečeni dijamantskim diskom u vlažnoj sredini pri brzini do 6000 obr/ min. Prvo je diskom odvojen korenski od kruničnog dela, a zatim su zubi presečeni transverzalno po sredini mezio-distalnog prečnika zuba. Potom je na svakoj polovini dijamantskim diskom napravljeno po tri preseka prosečne debljine 1.5mm

Penetracija zalivača jamica i fisura je analizirana uz pomoć SEM (JEOL/ EO, Japan) na sledeći način. Na uveličanuju od 30X je konstruisana horizontalna referentna interkuspalna linija **rl** (slika1), standardne dužine od 500 mikrometara koja se pružala između bukalnog i lingvalnog kuspalnog nagiba, transverzalno u odnosu na presek kvržica. Vertikalno na ovu liniju konstruisana je druga linija, **df,** koja se pružala od referentne horizontalne linije do dna okluzalnog udubljenja. Rastojanje od horizontalne linije, **rl** do dna udubljenja je registrovano i ova vrednost je označavala dubinu fisure. Ukoliko je izmerena vrednost bila veća od 1mm fisura je smatrana dubokom, a ukoliko je bila manja od 1mm, fisura je smatrana plitkom. Penetracija zalivača je registrovana kao rastojanje od referentne linije do najniže (najbliže bazi fisure) tačke gde je prisutan materijal za zalivanje, i ova linija je označena kao **pz .**

Resin-based sealant Helioseal-F (Ivoclar, Vivadent, Liechtenstein) and Glass ionomer (GC VII, Fuji) were used in the study. Both sealants were applied simulating the exact clinical procedure. Cleaning tooth debris on occlusal surfaces was done with a bursh and paste containing no fluoride and glycerin.

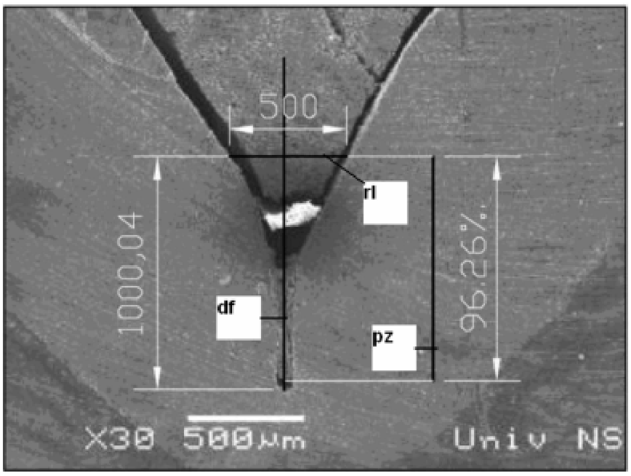
Prior to resin-based sealant application, acid etching with 37% phosphoric acid gel for 20 sec. was done and the teeth were rinsed for 15 sec and dried with gentle air stream for 15 sec. The sealant was applied and light-polymerized for 40 sec. Polishing in wet conditions was done with silicone rubber.

Glass ionomer sealant was applied after tooth conditioning with 10% polyacrylic acid (GC Cavity Conditioner, GC, Japan) for 10 sec. After 15 sec. rinsing and 15 sec drying, the sealant was applied followed by application of protective varnish which was polymerized for 20 sec.

Until the beginning of the experiment, teeth were stored in distilled water at +4ºC.

Seven days after sealant application, teeth were prepared for SEM: cut with a diamond disc with water cooling at 6000/min speed. First, the crowns were separated from the roots, and then teeth were cut transversally at the greatest mesio-distal diameter. After that, three sections of cca 1.5 mm were made with a diamond disc.

Sealant penetration was analyzed with SEM (JEOL/ EO, Japan). At 30x magnification, horizontal intercuspal reference line **rl** (figure 1) of 500 microns in length was constructed between buccal and lingual slopes, perpendicular to cusp section. Perpendicular to this line, another one was constructed , **df,** from the reference horizontal line towards the bottom of the fissure. Distance between **rl** and the bottom of the fissure was measured and it was the fissure depth. If this value was greater 1 mm, fissure was regarded deep, if it was smaller than 1 mm, fissure was regarded shallow. Sealant penetration value was the distance between the reference line and the lowest (nearest to the fissure base) point where the sealant was present, and this line was named **pz.**



Slika 1. Objektivizacija dubine fisura i jamica izvršena konstrukcijom referentne interkuspalne linije
Figure1. Fissure depth objectivisation using constructed intercuspal line

Penetracija zalivača je izražavana u procentima i izračunavana po formuli:

P=(pz/df)x 100

Dimenzije zalivačem nepopunjenog prostora na dnu fisure su odredjivane tako što je na fotografijama sa SEM zjap na dnu okluzalnog udubljenja posmatran na uveličanju od 500X i izvršeno je merenje kalibrisanom skalom njegovog najvećeg dijametra **d**(slika 2)**.**

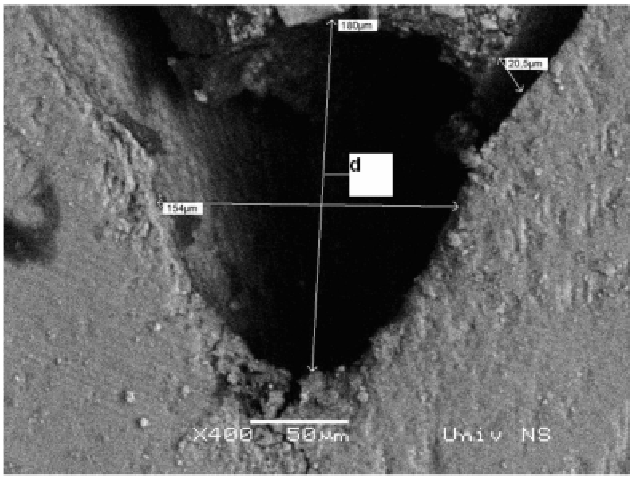
Procena penetracije materijala za zalivanje u odnosu na dubinu fisure je izražena srednjim vrednostima dubine penetracije **P** prethodno klasifikovanih fisura na duboke i plitke.

Sealant penetration was expressed as percentage and calculated according to the formula:

P=(pz/df)*100

At SEM micrographs, the greatest diameter between the sealant and the fissure bottom was measured at 500x magnification using a calibrated scale (figure 2).

Sealant penetration was expressed through the mean values of penetration **P** of fissures which were classified as deep or shallow.



Slika2. Merenje dubine zjapa na dnu okluzalnog udubljenja
Figure 2. Measurement of unfilled space depth at the base of occlusal groove

Rezultati

Dobijeni rezultati su prikazani u tabeli 1, grafikonu 1 i fotografijama 1 i 2.

Dubina penetracije materijala za zalivanje fisura i jamica je izražavana u procentima u odnosu na celokupnu dubinu fisure. Prosečna vrednost za dubinu penetracije za glas jonomerni zalivač iznosila je 83%, a za kompozitni zalivač 81% (tabela1). Nešto veća prosečna vrednost penetracije za glas jonomerni zalivač u odnosu na kompozitni nije bila statistički značajna (p>0.05).

Results

The results are shown in table 1, graph 1 and figures 1 and 2.

Penetration depth of fissure sealants was expressed as percent of the entire fissure depth. Mean penetration value for glass ionomer sealant was 83% and for resin-based 81% (table1). Slightly higher penetration value for glass ionomer sealant was not statistically significant (p>0.05).

The unfilled space at the bottom of the fissure was expressed through the greatest diameter **d** of this space,

Tabela 1. Prosečne vrednosti dubine penetracije i zalivačem nepopunjenog prostora na dnu fisure u ispitivanim grupama

Table1. Fissure sealant penetration depth and average size of unfilled space at the base of the fissure

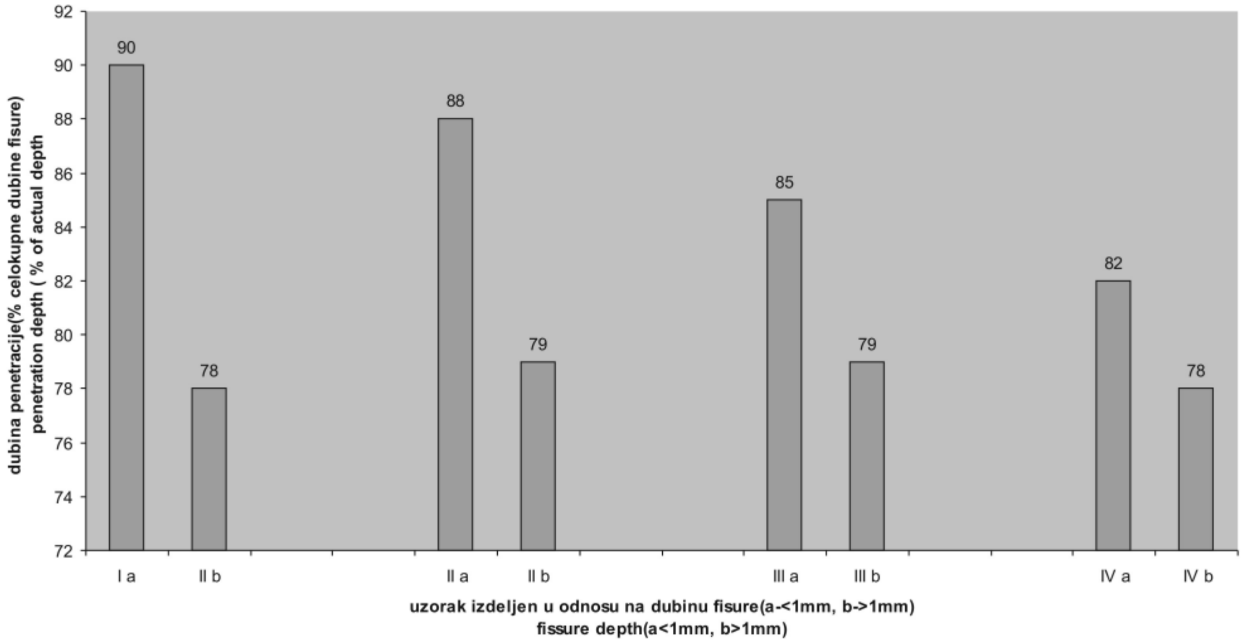
	dubina penetracije-izražena u procentima ukupne dubine fisure penetration depth-% of actual fissure depth	dimenzije nepopunjenog prostora izražene u mikrometrima size of the voids at the base of the fissure-(in microns)
glas jonomerni zalivač korišćen na premolarima. glassionomer sealant placed in premolars	84	91
glas jonomerni zalivač korišćen na III molarima. glassionomer sealant placed in molars	83	96
kompozitni zalivač korišćen na premolarima resin based sealant placed in premolars	83	94
kompozitni zalivač korišćen na III molarima resin based sealant placed in molars	81	100

Prostor na dnu fisure koji je ostao nepopunjen materijalom za zalivanje je izražavan najvećim dijametrom **d** ovog prostora koji je bio najčešće nepravilnog ovalnog oblika(slika2). Prosečne vrednosti ovog dijametra za glas jonomerni cement su bile 93, a za kompozitni materijal 95 mikrometara(tabela1). Razlika takođe nije bila statistički značajna.

Analiza je pokazala da su 37% fisura premolara i 45% fisura trećih molara registrovane kao duboke. Rezultati dubine penetracije materijala u odnosu na dubinu fisure su potvrdili da je dubina penetracije manja u dubokim fisurama u obe grupe zuba i kod oba ispitivana materijala. Ova razlika je bila statistički značajna($p<0.05$)(grafikon 1.)

which was most frequently of imperfect oval shape (figure 2). Mean diameter for glass ionomer sealant was 93 µm and for resin-based sealant 95 µm (table 1). This difference was not statistically significant.

The analysis revealed that 37% of premolar and 45% of molar fissures were classified as deep. Sealant penetration was lower in deep fissures in both groups of teeth and for both tested materials. This difference was statistically significant ($p<0.05$) (graph 1).



Grafikon 1. Dubina penetracije materijala u odnosu na dubinu fisure
Graph 1 Sealant penetration depth in funcion of fissure type

Diskusija

Prednosti eksperimentalnih studija, koje se rade na ekstrahovanim zubima je u tome što je moguće posmatrati apsolutnu dubinu jamica i fisura. Medjutim, ni tu u literaturi ne postoji ujednačeni metod kojim se odredjuje dubina fisura. U mnogim studijama, fisure su klasifikovane samo na osnovu svojih morfoloških karakteristika, pa se razlikuje U, V, Y1 i Y2 tip fisure, (9,10,11). U sprovedenoj studiji je izvršena objektivizacija dubine fisura na osnovu konstruisane referentne linije dužine 500 mikrometara koja prati nagib zidova kvržica. Ovaj metod je korišćen u eksperimentalnoj studiji Cowey-a, Johnson-a i Hopper-a(12), a njegova pouzdanost je u tome što u isto vreme povezuje dubinu fisure i njenu širinu, kao podjednako važne faktore koji mogu uticati na penetraciju materijala za zalivanje.

Discussion

The advantage of *in vitro* over *in vivo* studies is that it is possible to determine absolute depth of pits and fissures. However, there is no uniformly accepted method for determining fissure depth. In many studies, fissure are classified according to their morphological characteristics as U, V, Y1 and Y2 types (9, 10, 11). In the present study, fissure depth measurement was done based on the reference horizontal line of 500 µm between cusp slopes. This method was used in the study of Cowey et al. (12). Its reliability lies in the fact that it embraces both fissure depth and width, as equally important factors for sealant penetration.

U kliničkoj praksi se danas za zalivanje jamica i fisura najčešće koriste dve velike grupe materijala, kompoziti i glas jonomerni cementi. Kompozitni zalivači sa fluoridima su nastali kao težnja da se ovom materijalu odličnih mehaničkih i retencionih karakteristika doda terapijsko i preventivno delovanje fluorida. Glasjonomerni zalivači svoje mesto u primeni kao materijali za zalivanje fisura svoj osnovni efekat zasnivaju na hemijskoj vezi koju ostvaruju sa zubnim tkivima i kontinuiranom oslobadjanju fluorida.

Materijali korišćeni u ovoj studiji su prema mnogim istraživanjima reprezentativni predstavnici svojih grupa(13,14,15). Kompozitni zalivač sa fluorom (Helioseal F), predstavlja unapredjeni proizvod ranijih vrsta kompozitnih zalivača. Neprovidan je i na kontrolnim pregledima se lako uočava inspekcijom. Glas jonomerni zalivač koji je korišćen u studiji je Fuji VII, pored hemijskog vezivanja ima znatno veći i dugotrajniji potencijal otpuštanja fluorida. Svetloružičasta boja materijala omogućava laku kontrolu inspekcijom, a popravljene mehaničke osobine, veća adheziona sposobnost i činjenica da je otpuštanje značajno veće u odnosu na sve do sad predstavljene materijale za zalivanje fisura, osnovni su razlozi što ovaj materijal korišćen u sprovedenom istraživanju.

S obzirom da u savremenoj literaturi postoji neusaglašeno korišćenje termina za strukture na okluzalnoj površini zuba u ovom radu su analizirane sve strukture koje čine fisurni kompleks premolara i molara, u koje se ubrajaju brazde (fissurae) i jame (fossae dentales) Međutim, zbog ustaljene terminologije u čitavom radu svi ovi elementi se nazivaju jamicama i fisurama. U odredjenom broju radova ovaj problem je prevazidjen tako što su svi elementi fisurnog kompleksa zuba nazivani okluzalnim udubljenjima (occlusal grooves)(12).

Veoma je dobro dokumentovana činjenica da je morfologija okluzalnog sistema zuba značajan faktor rizika za nastanak karijesa(16,17,18), pa je zato zalivanje jamica i fisura značajna profilaktička mera. Iako jamice i fisure čine svega 12.5% površine zuba karijes na ovim površinama zauzima 88% ukupnog karijesa dece(19).

Korektna tehnika postavljanja zalivača jamica i fisura ima za cilj dobru penetraciju u uzane i teško dostupne delove jamica i fisura. Ne postoji materijal koji je u stanju da potpuno prodre do dna ovakvih fisura, pa je razumljiv odredjeni stepen rezerve kod nekih kliničara da postoji mogućnost da se u nezalivenom prostoru nalaze bakterije, kao i da se zalivač postavi preko incipijentne karijesne lezije. S druge strane postoje brojni dokazi da bakterije ne ostaju vitalne i karijesna lezija se ne širi ukoliko se zalivač postavi preko incipijentne karijesne lezije(20,21,22). Materijal od koga su sačinjeni zalivači eliminiše izvor hrane za S.mutans, i tako preobražava karijesnu leziju iz aktivne u inaktivnu(23).

Korišćenje skening elektronskog mikroskopa omogućava direktnu vizuelnu opservaciju dubine penetracije materijala i adaptacije uz zidove fisura, prvenstveno zbog mogućnosti posmatranja na velikim uveličanjima i dubini fokusa(13).

Dobijeni rezultati koji se odnose na mogućnost penetracije 2 testirana materijala pokazuju da oba materijala u

Two large groups of materials are used for sealing pits and fissures in contemporary clinical practice, resin-based and glass ionomer cements. Resin-based sealants with fluoride release have been developed in the effort to add therapeutical and preventive effect of fluoride to a material of excellent mechanical and retentive characteristics. Application of glass ionomers as fissure sealants is based upon their ability to form chemical bond with tooth tissues and the continuing fluoride release.

Materials in this study are representative for their groups according to many studies (13, 14, 15). Resin-based sealant with fluoride (Helioseal-F) is an improved descendant of previous resin-based sealants. It is not transparent and is easily recognized at check-ups. Glass ionomer sealant in this study was Fuji VII has a substantial and long-lasting fluoride release potential and also chemical bonding ability. Light pink colour of the material enables easy visual detection at check-ups, improved mechanical properties, higher adhesive ability and greater fluoride release than any other fissure sealant were the reasons for using Fuji VII in this study.

Since there is no terminological uniformity for occlusal structures, all structures forming fissure complex of premolars and molars were analyzed in the present study. These structures comprise fissures (fissurae) and pits (fossae dentales). This terminological problem has been overcome in some articles by introducing the term “occlusal grooves” for all elements of the fissure complex (12).

The fact that occlusal morphology is an important factor for caries development is very well documented (16, 17, 18), which makes fissure sealing an important prophylactic measure. Although pits and fissure form only 12.5% of tooth surfaces, caries in pits and fissures occurs in 88% of all caries in children (19).

Appropriate technique of fissure sealant application is aimed at deep penetration in narrow and unreachable parts of pits and fissures. No material is able to penetrate down to the bottom of such fissures. Therefore, it is understandable that some clinicians suspect that there are bacteria in unfilled space or that the sealant is often placed over an incipient caries lesion. On the other hand, there is evidence that bacteria cannot remain vital and that caries lesion stops if the sealant is placed over an incipient lesion (20, 21, 22). Sealing material eliminates nourishment sources for S. mutans and converts an active into the passive caries lesion (23).

Scanning electron microscopy enables direct visual observation of material penetration and adaptation to fissure walls due to high magnification and focal depths (13).

proseku dopiru do više od 80% ukupne dubine fisure. Ovi rezultati su saglasni sa nalazima sličnih studija u kojima je primećeno da materijal za zalivanje fisura dopire duboko u jamice i fisure ali ne doseže do njihovog dna. U studiji koju su sproveli Cowey, Johnson i Hopper zabeležena je penetracija od 70% i za kompozitne i za glasjonomerne zalivače(12). I u studijama Jasmin-a i Herle-a, pokazano je da bez obzira na vrstu materijala i dobru penetraciju, ne postoji zalivač koji doseže do samog dna fisure(13). Symons navodi da zalivači fisura pokazuju veoma dobru adaptibilnost uz vertikalne zidove fisura, ali izostaje penetracija u najdublje morfološke aspekte na dnu fisure(9). Duangthip i Lussi takodje beleže podatak da zalivači ne mogu prodreti do dna dubokih fisura, sa ampularnim proširenjima ili konstrikcijama(10,11).

Dublja penetracija (87% u proseku) u plitkim jamicama i fisurama u odnosu na duboke(78.5% u proseku) je očekivana i potpuno korespondira sa rezultatima objavljenim u literaturi(9,12) u kojima je zabeležena statistički značajno bolja penetracija kod dubokih nego kod plitkih fisura. Ovom eksperimentalnom studijom je takodje potvrđeno da je okluzalna morfologija limitirajući faktor penetracije materijala za zalivanje jamica i fisura.

Prisustvo praznog prostora na dnu fisure je neminovnost na koju se mora računati čak i sa najsavreminijim materijalima za zalivanje. Relativizacijom dubine fisura, dimenzije ovog prostora ne mogu biti na odgovarajući način evaluirane. Cowey u svojoj studiji veličinu praznog prostora objektivizira računanjem njegove površine(12). U ovoj studiji je meren najveći dijametar praznog prostora, koji je najčešće nepravilnog ovalnog oblika. Prosečni dijametar zjapa na dnu fisure, koji iznosi oko 100 mikrometara, govori u prilog tome da nemogućnost penetracije zalivača ne sme biti zanemarena, da materijali moraju ispoljavati izražene profilaktičke karakteristike i da procedura postavljanja mora biti besprekorna i u skladu sa indikacijama, kako bi se onemogućilo nastajanje karijesne lezije ispod postavljenog zalivača.

Results in this study suggest both tested sealant materials penetrate more than 80% of entire fissure depth. These results are in accordance with similar studies which conclude that fissure sealant penetrates deep into occlusal grooves but not entirely down to the bottom. Cowey et al recorded penetration of 70% for both resin-based and glass ionomer sealants (12). Studies of Jasmin and Herle also suggest that there is no sealant that reaches the bottom of the fissure (13). Symons states that fissure sealants show very good adaptability against vertical fissure walls, but lack the ability to penetrate entirely to the fissure bottom (9). Duangthip and Lussi also state that sealants cannot reach bottom of deep fissures, ampular or constrictive fissures (10, 11).

Deeper penetration (87%) in shallow pits and fissures than in deep ones (78.5%) was expected and fully corresponds to literature results (9, 12). This *in vitro* study also proves that occlusal morphology is a limiting factor for penetration of fissure sealants.

Unfilled space at the bottom of fissures is inevitable and must be counted for, even with the most recent sealing materials. By relativization of fissure depth, dimensions of the unfilled space cannot be evaluated adequately. Cowey determines the size of this space by measuring its surface (12). In the present study, the greatest diameter of the unfilled space was measured . The mean diameter of 100 μm shows that sealant inability to fully penetrate fissures must not be neglected, that materials must have significant prophylactic characteristics and that application procedure must be faultless and in accordance with indications in order to disable caries lesion development under fissure sealant.

Zaključak

Na osnovu sprovedene studije može se zaključiti da je morfologija jamica i fisura značajan faktor penetracije materijala za zalivanje. Dublja penetracija kod oba zalivača uočena je kod plićih fisura. Kompozitni i glasjonomerni zalivači se podjednako efikasno mogu koristiti kod molara i premolara.

Conclusion

Based on the results of the present study, it can be concluded that morphology of pits and fissures is an important factor for penetration of fissure sealants. Deeper penetration of both tested materials occurs in shallow fissures. Resin-based and glass ionomer sealants can be used for premolars and molars equally efficiently.

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