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Učinkovitost materijala za pečačenje u petogodišnjem radu studenata i pedodonata

Evidence Based Effectiveness of Pit and Fissure Sealants Applied by Students and Paediatric Dentists After Five Years

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Sažetak

Uvod: Materijali za pečačenje dobro su istraženi u laboratorijskim i kliničkim istraživanjima. Iskusni pedodonti, ali i studenti te stomatolozi, često se koriste materijalima za pečačenje kao preventivnom mjerom u dječjoj stomatologiji. **Svrha:** 1. Usporediti ishod pečačenja u primarnoj i trajnoj denticiji koje obavljaju studenti i pedodonti; 2. Usporediti ishod pečačenja u kliničkom i laboratorijskom okruženju. **Materijal i načini:** Tijekom pet godina prikupljeni su podaci o 6871 pečačenju i to iz kartona pacijenata privatne pedodontske ordinacije (PP-a) i nastavne institucije - Klinike za simulaciju ordinacije (SPEC-a) na Schulich Dentistry, University of Western Ontario, London, Kanada. Pečačeni zubi registrirani su kao intaktni, bez pečata te s karijesom. **Rezultati:** Statistička analiza obavljena je testom hi-kvadrat. Od ukupnog broja, nakon pet godina, bilo je 88,6 posto intaktnih pečata, 7,2 posto bilo je djelomice ili potpuno izgubljeno, a na 4,1 posto zuba razvio se karijes. U radu pedodonata i studenata na mliječnim zubima nije bilo statistički znatne razlike ($p > 0,05$). Statistički velika razlika ($p < 0,01$), ali ne i klinički znatna, bila je u radu studenata i pedodonata na trajnim zubima. Laboratorijska uspješnost od 95 posto odgovarala je kliničkom uspjehu od 93,5 posto te 98,4 posto zdravih trajnih zuba koje su tretirali studenti i stomatolozi. **Zaključci:** 1. Nakon pet godina 96 posto pečačenih i ponovno pečačenih zuba nije imalo karijes; 2. U laboratorijskim istraživanjima dobro se može predvidjeti ponašanje materijala za pečačenje *in vivo*.

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Uvod

Pečačenje jamica i fisura koristi se za prevenciju okluzalnog karijesa koji čini do 90 posto karijesa kod djece (1). Koliko se zahvaćene, ovisi o općem riziku za karijes kod svakog djeteta, ali i o dubini i obliku struktura zuba (2,3). Učinkovitost pečačenja jamica i fisura ovisi o čimbenicima postavljanja, kao što su pravilna izolacija radnog polja (4 - 8) te jetkanje i mehanička preparacija zuba (9-11). Pri-

Introduction

Pit and fissure sealants are used for the prevention of occlusal caries, which represent up to 90% of caries in children (1). The extent of pit and fissure caries is related to the presence of general caries risk factors for each child including depth and form of tooth structures (2-3). The effectiveness of pit and fissure sealants depends on placement factors such as use of proper field isolation (4-8), and acid etch-

rodno vezivanje (12), sredstvo za vezivanje (13,14), sredstvo za sušenje (15) te polimerizacija (16) materijala za pečaćenje, također utječu na učinkovitost materijala za prevenciju karijesa.

U literaturi je mnogo dokaza o učinkovitosti pečaćenja kako bi se prevenirao okluzalni karijes u više od 70 posto primarnih i trajnih denticija (17-19). S druge strane, Mejàre i suradnici su u opsežnom pregledu literature opisali redukciju rizika za karijes od samo 33 posto na prvim trajnim molarima pomoću pečaćenja jamica i fisura (20). Literatura upućuje na daljnja istraživanja kako bi se procijenila učinkovitost materijala za pečaćenje mliječnih i trajnih zuba.

Malo je prospektivnih i retrospektivnih kliničkih istraživanja o materijalima za pečaćenje u rukama studenata, dentalnih higijeničara, dentalnih asistenata, stomatologa i pedodonata (1,21-22). Nema studija u kojima se uspoređuje kliničko ponašanje materijala kada ga postavljaju studenti i njihovi učitelji. Također nema istraživanja o tome kako se stvrđjava isti materijal u kliničkom radu i laboratorijskom okružju. Svrha ovoga istraživanja bila je usporediti rezultate materijala za pečaćenje jamica i fisura mliječnih i trajnih zuba kada to tijekom pet godina rade studenti stomatologije te njihovi instruktori – pedodonti te analizirati ponašanje materijala u kliničkom i laboratorijskom okružju.

Materijal i metode

Ovo je istraživanje obavljeno na materijalima koje su postavljali studenti u Klinici za simulaciju ordinacije (SPEC-u) na Schulich School of Medicine & Dentistry, University of Western Ontario, Kanada, specijalisti pedodonti (instruktori u SPEC-a) te pedodonti u Pedodontskoj klinici (PP-u). Podaci su prikupljeni iz kartona pacijenata kojima su mliječni i/ili trajni zubi zapečaćeni u razdoblju 1. siječnja godine 1998. do 1. srpnja 2003. Identiteti su bili tajni te su svima bili dodijeljeni slučajni brojevi. Koršten je standardni FDI-jev kod za bilježenje zuba u istraživanju. Integritet pečata pratio se pet godina kod svakog pacijenta. Kriteriji za odabir kartona zahtijevali su redovite kontrole pacijenata tijekom pet godina. Pečaćenja i svi ispuni svaki su put pažljivo pregledani. Važno je znati da je u SPEC-u mnogo kartona izgubljeno zbog toga što djeca nisu dolazila na kontrolu. Integritet pečaćenja bilježio se kao: A - intaktan, zub se i dalje prati; B - pečaćenje je dje-

ing and mechanical tooth preparation (9-11). The natural bonding (12), bonding agent (13-14), drying agent (15) and curing agent (16) of sealant materials also influence the effectiveness in caries prevention of the sealant.

There is ample evidence in the literature demonstrating effectiveness of pit and fissure sealants in preventing occlusal dental caries for more than 70% of primary and permanent dentition (17-19). On the other hand, Mejàre et al., in a comprehensive review reported a caries risk reduction of only 33% in the first permanent molars by the use of pit and fissure sealants (20). The literature suggests that further research is needed to estimate the effectiveness of sealants in primary and permanent teeth.

There are a few prospective and retrospective clinical studies showing the clinical performance of pit and fissure sealants applied by dental students, dental hygienists, dental assistants, dentists and paediatric dentists (1, 21-22). There are no studies, however, that compare the clinical performance of sealants placed by students and those placed by their instructors – paediatric dentists. There are also no studies that compare the sealing ability of the same sealant material in clinical and laboratory settings. The aims of this study are to compare the performance of pit and fissure sealants applied to primary and permanent teeth by dental students and by their paediatric dental instructors over a five-year period, and to compare the performance of the sealant material in clinical and laboratory settings.

Material and Methods

This study was carried out on sealants placed by students at the Simulated Private Practice Environment Clinic (SPEC) student teaching facility at the Schulich School of Medicine & Dentistry, University of Western Ontario, Canada, and by paediatric dentists (instructors in SPEC) at a private paediatric dental clinic (PP). Data were collected from entries in all charts of patients who had their primary and/or permanent teeth sealed between January 01, 1998 and July 01, 2003. Patient identity was kept confidential and patients were identified by arbitrary numbers. The standard FDI tooth codes were used to identify teeth in this study. Sealant integrity was followed in each patient for 5 years. Inclusion criteria for reviewing patients' charts required that the patient had attended regular recall exams for the 5-year period. Sealants and all restorations are always carefully evaluated at each recall examination. It is important to note that at SPEC, many charts were

lomice ili potpuno odsutno, ali nema karijesa, zub treba ponovno zapečatiti; C - karijes ispod ili oko pečaćenja, zub treba opskrbiti ispunom.

Pacijenti, djevojčice i dječaci, bili su u dobi od 2 do 12 godina. Tijekom istraživanja studenti su stavili pečate na ukupno 2794 mliječna i trajna zuba 692 pedodontska pacijenta - svi su ispunjavali kriterije za uključivanje u istraživanje. U PP-u je bilo postavljeno ukupno 4077 pečaćenja kod 1239 pacijenata – i oni su svi zadovoljavali kriterije za uključivanje tijekom pet godina. Podaci su analizirani testom hi-kvadrat.

Važno je istaknuti da instruktori uče studente istim metodama koje oni sami obavljaju u svojim privatnim ordinacijama. Zato je na objema lokacijama bila provedena ista klinička procedura.

Pravilna izolacija radnog polja koferdamom koristila se za većinu preparacija, kako bi se postigla suha okluzalna površina. Vaterolice su rabljene tada kada nije bilo moguće postaviti koferdam, tj. kod djelomice izraslih zuba. Karbidnim svrdlom promjera 0,5 mm očišćena je i abradirana caklina. U svim slučajevima koristilo se sredstvo za pečaćenje u štrcaljki Ultraseal XT plus (Ultradent®). Na zrakom osušenu površinu zuba primijenjen je Ultra-Etch (35%-tna fosforna kiselina u gelu) tijekom 20 sekundi te je zatim isprana nakon 20 sekundi, a zatim su zubi osušeni zrakom. Slijedila je primjena otopine PrimaDry na jamice i fisure te su zubi osušeni komprimiranim zrakom. U jamice i fisure postavljen je Ultraseal XT plus te je 30 sekundi bio polimeriziran svjetlom.

Laboratorijska mikropropusnost

U ranije objavljenom laboratorijskom istraživanju provedenom na fantomima SPEC-a na Schulich School of Medicine & Dentistry, University of Western Ontario, Kanada, ispitivao se prodor boje u ekstrahirane ljudske trajne zube pečaćene materijalom Ultraseal XT plus (Ultradent®) (15). Isti materijal i postupak rabljen kod djece, primijenjen je i na fantome. Određivale su se vrijednosti penetracije metilenskog modrila od 0 do 3 kao procjena mikropropusnosti. Laboratorijska vrijednost 0 označavala je da nema prodora boje između materijala za pečaćenje i cakline. Vrijednosti 1 i 2 značile su da je boja prodrla do polovice dubine sloja materijala za pečaćenje. Grupirane laboratorijske vrijednosti (1 ili 2) odgovarale su kliničkoj vrijednosti B, to jest onim mjestima na kojima je materijal za pečaćenje

excluded because of children's failure to keep their recall appointments. Sealant integrity was always recorded in the clinics as: A, intact sealant; the tooth remains under observation; B, sealant partially or completely absent with no caries; the tooth needs to be resealed; or C, caries detected under or around the sealant; the tooth needs to be restored.

Patients, both male and female, ranged in age from 2 to 12 years. During the period of the study, students placed a total of 2794 sealants in primary and permanent teeth of 692 paediatric patients, all meeting the inclusion criteria. At the PP, a total of 4077 sealants were placed in 1239 patients who met the inclusion criteria over the same 5-year period. All data were analyzed for statistical significance using a Chi-square test.

It is important to mention that instructors (paediatric dentists) teach the same methods that they use in their private offices. Therefore, the same clinical procedure was carried out at both locations.

Proper field isolation using the rubber dam were used for most tooth preparations to ensure a moisture free occlusal surface. Cotton roll isolation was used in those situations where rubber dam isolation was not possible, eg. partially erupted teeth. A ½ round carbide bur (0.5 mm diameter) was used to clean and abrade the enamel. In all cases, the syringed Ultraseal XT plus (Ultradent®) sealant system was used. Ultra-Etch (35% phosphoric acid gel) was applied to air-dried tooth surfaces for 20 seconds, then rinsed for 20 seconds and the teeth air-dried. Following that, PrimaDry solution was applied to the pits and fissures and the teeth were finally air dried. Ultraseal XT plus pit and fissure sealant was applied and light cured for 30 seconds.

Laboratory Microleakage

A previously published laboratory study completed on mannequins at SPEC, Schulich School of Medicine & Dentistry, University of Western Ontario, Canada, investigated dye penetration in extracted human permanent teeth sealed with Ultraseal XT plus (Ultradent®) (15). The same material and procedure that was used on children was also applied on the mannequins. Methylene blue dye penetration of score 0-3 was used to assess microleakage as described in the study. A laboratory score of 0 indicated that the dye did not penetrate between the sealant and the enamel. For comparison purposes, this score was deemed the same as an intact sealant in a patient. A laboratory score of 1 or 2 indicated that the dye penetrated up to half the depth of the sealant layer. The grouped laboratory scores (1 or 2) corre-

ćenje nedostajao potpuno ili djelomice, ali nije bilo karijesa. U tom slučaju zubi su bili ponovno pečaćeni. Vrijednost 3 označavala je situacije u kojima je boja prodrla do cakline ispod materijala, a odgovarala je kliničkoj vrijednosti C, to jest karijesu ispod ili oko materijala za pečaćenje, a to zahtijeva izradu ispuna.

Rezultati

Rezultati o stanju materijala tijekom pet godina na SPEC-u i PP-u prikazani su u Tablici 1. i na Slici 1.

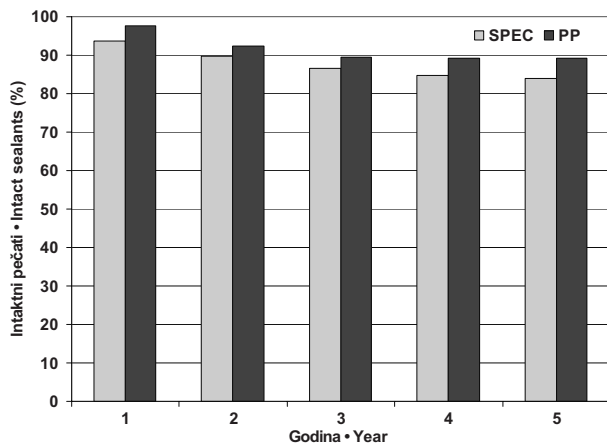
sponded with the clinical score B, where the sealant was partially or completely absent with no caries. In this case, the teeth were resealed A score of 3 represented complete penetration of the dye to the underlying enamel and corresponded with the clinical score of C, caries detected under or around the sealant and requiring restoration.

Results

The results of sealant condition over the five-year period at SPEC and PP are shown in Table 1 and Figure 1.

Tablica 1. Ishod stanja materijala tijekom pet godina na SPEC-u i PP-u
Table 1 Outcome of sealant performance over the five-year period at SPEC and at PP.

Lokacija • Location	Zubi • Teeth	Broj pečaćenja • Number of sealants	Intaktni • Intact A		Ponovno pečaćeni • Resealed B		Ispunjeni • Restored C		Bez karijesa: intaktni i ponovno pečaćeni • Caries Free: intact and resealed A+B	
			#	%	#	%	#	%	#	%
SPEC	Mliječni • Primary	124	105	84.7	8	6.5	11	8.9	113	91.1
	Trajni • Permanent	2670	2215	83.0	284	10.6	171	6.4	2499	93.5
PP	Mliječni • Primary	474	408	86.1	23	4.9	43	9.1	431	91.0
	Trajni • Permanent	3603	3363	93.3	183	5.1	57	1.6	3546	98.4
UKUPNO • TOTAL		6871	6091	88.6	498	7.2	282	4.1	6589	95.8



Slika 1. Postoci intaktnih pečaćenja u mliječnoj i trajnoj denticiji tijekom pet godina na SPEC-u i PP-u
Figure 1 Percentage of intact sealants in primary and permanent teeth over the five-year period at SPEC and PP.

Ukupno je na SPEC-u i PP-u analizirano 6871 pečaćenje. Tijekom pet godina je 6091 (88,6%) zub bio intaktan, 498 (7,2%) ponovno je pečaćeno, a 282 (4,1%) su opskrbljena ispunom. Drugim riječima, 95,8 posto zuba bilo je bez karijesa (intaktni i ponovno pečaćeni).

Na SPEC-u je ukupna stopa uspjeha zuba bez karijesa (intaktni i ponovno pečaćeni, A ili B) iznosila 91,1 posto kod mliječnih zuba i 93,5 posto kod trajnih. Nije bilo statistički znatne razlike ($p > 0,05$) između mliječnih i trajnih zuba.

A total number of 6871 sealants were analyzed at SPEC and PP. Over the 5-year period, 6091 (88.6%) sealed teeth were intact, 498 (7.2%) were resealed and 282 (4.1%) were restored. In other words, 95.8% of teeth were caries free (intact and resealed).

At SPEC, the overall success rate observed as being caries free (intact or resealed, (A or B)) was 91.1% among primary teeth and 93.5% among permanent teeth. There was no statistical difference ($p > 0.05$) between primary and permanent teeth.

U PP-u su odgovarajuće stope iznosile 91,0 posto kod mliječnih zuba te 98,4 posto kod trajnih. Razlika između njih bila je statistički velika ($p < 0,05$).

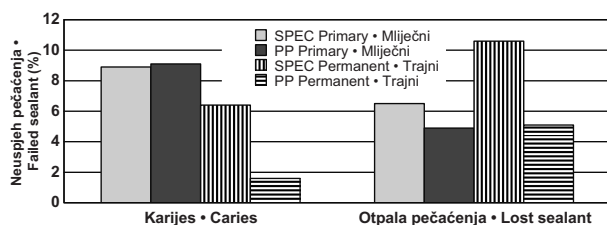
Nije bilo statistički znatne razlike kod mliječnih zuba između SPEC-a i PP-a ($p > 0,05$). No, kod trajnih je zuba bila statistički velika ($p < 0,01$), ali klinički neznatna razlika između SPEC-a i PP-a.

Tijekom istraživanja intaktna pečaćenja (bez potrebe da se postupak ponovi ili izrade ispuni) na mliječnim i trajnim zubima bila su češća u PP-u nego na SPEC-u. Usporedba ukupnog uspjeha pedodontata u PP-u s uspjehom studenata na SPEC-u pokazala je statistički znatnu razliku ($p < 0,01$). No, derivacija od nulte hipoteze bila je premala da bi se radilo o kliničkoj znatnosti.

Analiza kumulativnog neuspjeha za sva pečaćenja nakon pet godina (ponovno pečaćeni -B i ispunom opskrbljeni zubi- C prikazana je na Slici 2. Pronađeno je 0,2 posto više karijesa na mliječnim zubima u PP-u nego na SPEC-u te 4,8 posto više karijesa (ispun (C) na trajnim zubima na SPEC-u nego u PP-u. Otpalih pečaćenja (ponovno pečaćeni -B) bilo je više na SPEC-u nego u PP-u i na mliječnim (1,6%) i na trajnim (5,5%) zubima.

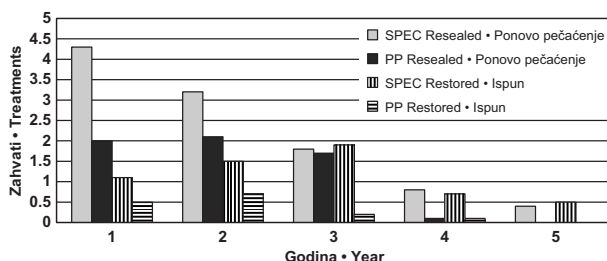
Godišnja distribucija ponovljenih zahvata na mliječnim i trajnim zubima na SPEC-u i u PP-u prikazana je na Slikama 3. i 4.

Na SPEC-u gotovo sva djelomice ili potpuno otpala pečaćenja na mliječnim zubima, ponovljena su tijekom prve godine. Stopa neuspjeha pečaćenja ti-



Slika 2. Kumulativni neuspjeh svih pečaćenja tijekom pet godina; karijes (C) i otpala pečaćenja (B)

Figure 2 Cumulative failure of all sealants after five years; caries (C) and lost sealant (B).



At PP, the corresponding rates were 91.0% among primary teeth and 98.4% among permanent teeth. There was statistical significant difference ($p < 0.05$) between primary and permanent teeth.

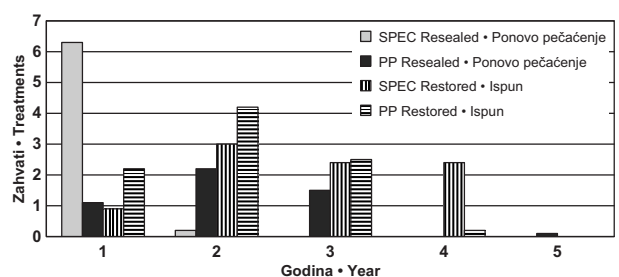
There was no significant difference ($p > 0.05$) between primary teeth at SPEC and at PP. There was, however, significant statistical difference ($p < 0.01$) but no clinical difference between permanent teeth at PP and at SPEC.

Intact sealants (no need for resealing or restoration) among primary and permanent teeth combined were consistently more at PP than at SPEC throughout the duration of the study. A comparison of overall success of paediatric dentists at PP with that of students at SPEC showed a statistically significant difference ($p < 0.01$). However, the deviation from the null hypothesis was too small to be of clinical significance.

Analysis of cumulative failure after five years of all sealants (resealed (B) and restored (C)) is shown in Figure 2. 0.2% more caries in primary teeth at PP than at SPEC and 4.8% more caries (restored (C)) were found in permanent teeth at SPEC than at PP. There was more lost sealant (resealed (B)) at SPEC than at PP in both primary (1.6%) and permanent (5.5%) teeth, respectively.

The annual distribution of treatments of failed sealants in primary and permanent teeth at SPEC and at PP is presented in Figs. 3 and 4.

At SPEC, almost all partially or completely lost sealants of primary teeth were resealed in the first



Slika 3. Godišnja distribucija ponovljenih zahvata na mliječnim zubima na SPEC-u i u PP-u.

Figure 3 Annual distribution of treatments of failed sealants in primary teeth at SPEC and at PP.

Slika 4. Godišnja distribucija ponovljenih zahvata na trajnim zubima na SPEC-u i u PP-u.

Figure 4 Annual distribution of treatments of failed sealants in permanent teeth at SPEC and at PP.

jekom pet godina iznosila je 6,5 posto, a 6,3 posto pečaćenja otpalo je u prvoj godini. Potreba za liječenjem karijesa pojavila se uglavnom tijekom druge, treće i četvrte godine - najviše u drugoj. U PP-u se potreba za ponavljanjem pečaćenja i izradom ispuna uglavnom javljala u prve tri godine - najčešće tijekom druge.

Na SPEC-u je većina trajnih zuba ponovno pečaćena tijekom prve godine. No, većina je ispuna napravljena u trećoj godini, a zatim je neuspjeh pečaćenja bio mali. U PP-u je većina zuba ponovno pečaćena od prve do treće godine, a ispuni su bili izrađeni tijekom prve i druge godine nakon postavljanja pečaćenja.

Laboratorijska uspješnost pečaćenja na trajnim zubima - predstavljena u mikropropusnosti vrijednosti 0, 1 i 2 - iznosila je 95 posto. To je u skladu s kliničkim ishodom intaktnih (A) ili ponovno pečaćenih (B) zuba na SPEC-u od 93,5 posto te 98,4 posto u PP-u (Tablica 2.). Nije bilo statistički velike razlike ($p < 0,05$) između uspješnosti pečaćenja na trajnim zubima u laboratorijskim uvjetima i kliničkom okružju na SPEC-u i u PP-u.

Podaci su analizirani s obzirom na to koje je zube najčešće trebalo opskrbiti ispunima. Kod mliječnih zuba uglavnom se radilo o gornjem drugom desnom molaru, i to 16 posto na SPEC-u i 26 posto u PP-u. Kod trajnih zuba najčešće su se ponavljala pečaćenja i ispuni na gornjem desnom prvom molaru – 10 posto na SPEC-u i 3,8 posto u PP-u.

Osim toga, pokazalo se da je na SPEC-u 18 ispitanika imalo prvi trajni molar bez pečaćenja, a osta-

year. There was a 6.5% sealant failure rate over the entire five year period, and 6.3% of all sealants failed in the first year. The need for treatment of carious lesions occurred mostly in the second, third and fourth years, with the greatest occurrence in the second year. At PP, the need for resealing and restoration occurred mostly in the first, second, and third years, with the greatest occurrence in the second year.

At SPEC, the majority of permanent teeth were resealed in the first year. However, most teeth required restorations in the third year of sealant placement. Following that, failure of sealants was low. At PP, most permanent teeth were resealed in the first, second, and third years, while most restoration occurred in the first and second years of sealant placement.

Laboratory success of sealants in permanent teeth, represented by microleakage scores of 0, 1 or 2, was 95%. This compared well with the success in the clinical settings observed as intact (A) or resealed (B) sealant in SPEC 93.5% and in PP 98.4% (Table 2). There was no statistically significant difference ($p < 0.05$) between success of sealants in permanent teeth between laboratory and clinical settings at both SPEC and PP.

Data were also examined to determine which teeth most often needed restoration. Among primary teeth resealed and restored, primary second maxillary right molars most often needed resealing or restoration, 16% at SPEC and 26% at PP. Among permanent teeth resealed and restored, maxillary right first molars most often needed resealing or restoration, 10% at SPEC and 3.8% at PP.

Tablica 2. Usporedba uspjeha pečaćenja u laboratorijskom i kliničkom okružju
Table 2 Comparison of sealant success in laboratory and clinical settings.

Laboratorij • Laboratory				Klinika • Clinics					
Kriterij mikropropusnosti • Criteria for microleakage	Propusnost • Leakage		Lab. rezultat • Laboratory results (%)	Klinički nalaz • Clinical findings	Zahvat • Treatment	Klinički rezultati nakon 5 godina • Clinical results after 5 years			
						SPEC (%)		PP (%)	
0	Nema • None	Bez karijesa • No Caries (95%)	75	Intaktni pečat • Sealant intact	0	Bez karijesa • No Caries (93.5%)	83	Bez karijesa • No Caries (98.4%)	93.3
1	U vanjskoj polovici • Outer-half		18	Djelomični gubitak pečata - bez karijesa • Partial sealant lost – no caries	Resealed		10.6		5.1
2	U unutrašnjoj polovici • Inner-half		2	Većina pečata izgubljena - bez karijesa • Most of Sealant Lost – no caries	Resealed				
3	Potpuna • Complete	Karijes • Carious (5%)	5	Karijes ispod ili oko pečata • Caries present under or around sealant	Restored	Karijes • Carious (6.4%)	6.4	Karijes • Carious (1.6%)	1.6

la su tri prva trajna molara bila pečaćena. Od 18 nepečaćenih zuba kod 18 pacijenata, pet (27,8%) je razvilo karijes tijekom godinu dana te im je izrađen ispun. Od 54 pečaćena zuba pet (9,3%) je opskrbljeno ispunom nakon dvije godine, a dva (3,7%) nakon četiri godine. To potvrđuje da nepečaćeni zubi imaju trostruko veću mogućnost za karijes od pečaćenih, kod istog pacijenata s visokim rizikom za karijes.

Rasprava

Ovo istraživanje predstavlja klinički ishod materijala Ultraseal XT plus (Ultradent®) za pečaćenje jamica i fisura u radu studenata stomatologije i pedodonata na mliječnim i trajnim zubima tijekom pet godina.

Iskustvo u pečaćenju i odlučujući čimbenik za uspjeh, procjenjivao se usporedbom rada studenata stomatologije s radom njihovih instruktora pedodonata. Pokazalo se da 93,4 posto svih pečaćenih mliječnih i trajnih zuba koje su na SPEC-u pečatili i ponovno pečatili studenti te 97,5 posto zuba koje su u PP-u tretirali pedodonti, nakon pet godina nije razvilo karijes. Ti rezultati uvrštavaju se među najveće opisane vrijednosti u literaturi (7,18,19,22,24). Tijekom istraživanja intaktna su pečaćenja na mliječnim i trajnim zubima bila konzistentno u većem broju u PP-u nego na SPEC-u, na statistički znatnoj, ali klinički irelevantnoj razini. Trendovi su prikazani na Tablici 1. i Slici 1. Analiza mliječnih zuba pokazala je da je samo malo (0,2%) zuba pečaćenih u PP-u zahtijevalo ponovno pečaćenje, negoli onih obrađenih na SPEC-u. Možda je taj rezultat uzrokovao činjenicom da pedodonti tretiraju više djece sa specijalnim potrebama nego studenti na SPEC-u te da je postavljanje pečaćenja zahtjevnije (25). Studenti mogu uspješno postavljati Ultraseal XT plus na mliječne i trajne zube na razini usporedivoj, ili čak boljoj od, razine dentalnih higijeničara i asistenta (21,22), općih stomatologa (27) te pedodonata (18,28). Uspjeh studenata može se objasniti time da na SPEC-u uče iste metode kojima se koriste njihovi instruktori – pedodonti, da je uporaba koferdama obvezatna (24), a priprema fisura i jamica temeljita (9,15,18,27,31), da postoji asistencija te da se rabi izvrstan materijal (15,26). Vjerujemo da je među svim čimbenicima uspjeha najvažnija preparacija svrdlom. Općenito je prihvaćeno da se male karijesne lezije mogu pečaćenjem zaštititi od daljnjeg širenja (17,29). No, ima radova koji su u skladu s iskustvom prvog autora, a to je da se karijes

It was further found, that at SPEC, 18 patients had one first permanent molar unsealed while the other three first permanent molars were sealed. Of the 18 unsealed teeth in those 18 patients, five teeth (27.8%) developed caries within a year and required restoration. Of the 54 teeth that were sealed, five teeth (9.3%) were restored after two years and two teeth (3.7%) were resealed after four years. These findings indicate that unsealed teeth are three times more likely to become carious than sealed teeth in the same high risk patient.

Discussion

The current study presents the clinical outcomes of Ultraseal XT plus (Ultradent®) pit and fissure sealant applied by dental students and paediatric dentists to primary and permanent teeth over a period of five years.

Experience in sealant placement as a determinant of success was assessed by comparing the work of dental students with their paediatric dentist instructors. It was found that 93.4% of all primary and permanent teeth sealed and resealed at SPEC by students and 97.5% of teeth sealed and resealed at PP by paediatric dentists were caries free after five years. These results are among the highest reported for long term studies (7, 18-19, 22, 24). During the study, intact sealants (no need for restoring or resealing) among primary and permanent teeth combined were consistently higher at PP than at SPEC, at statistically but not clinically significant level. The trend was presented in Table 1 and Figure 1. Analysis of primary teeth showed that only slightly more teeth (0.2%) sealed at PP required restoration when compared with those sealed at SPEC. It is possible that such results could be because paediatric dentists attended to more children with special needs than at SPEC, making sealant placement and retention more challenging (25). The students can successfully apply Ultraseal XT plus (Ultradent®) pit and fissure sealant to the primary or permanent teeth at a level comparable to or even better than that of dental hygienists and dental assistants (21-22), general practitioners (27), and paediatric dentists (18, 28). This student success can be explained by the fact that at SPEC, students are taught the same methods used by their instructors-paediatric-dentists, there is mandatory use of the rubber dam (24), there is meticulous bur preparation of pits and fissures prior to sealant application (9, 15, 18, 27, 31), dental assistants are available, and a superior material is used (15, 26). We believe that among these contributing factors to success, mandatory bur preparation

može razviti i ispod intaktnog pečaćenja (22,24,31). Naše je iskustvo u radu u edukativnom i privatnom okruženju da se laganim otvaranjem fisura i jamica otkrivaju mnogobrojne karijesne lezije. Tada se one pravilno obrađuju preventivnim kompozitnim ispunima, a ne samo materijalom za pečaćenje. Mehanička preparacija znatno pridonosi boljoj retenciji pečaćenja u kliničkom okruženju (28) te manjoj stopi mikropropuštanja u laboratorijskim uvjetima (9,15). Ta je alternativa najbolja kako bi se izbjegnuo pristup „zapečatiti ga“.

Općenito, većina ponovljenih pečaćenja i ispun na SPEC-u i u PP-u obavljena je tijekom prve tri godine (Slike 3. i 4.), što upućuje na to da je održavanje pečaćenja ključno za uspješnu terapiju pečaćenjem. Uporaba materijala za pečaćenje u kombinaciji s drugim preventivnim postupcima, kao što je primjena topikalnog fluorida, najdjelotvornija je u prevenciji karijesa (1,29), baš kao što se i provodi na SPEC-u i u PP-u.

Naše je istraživanje pokazalo da gornji zubi češće zahtijevaju ispun nakon pečaćenja. Mliječni drugi molari i trajni prvi molari s desne strane, bili su zubi na kojima je najčešće bio potreban ispun, što je u skladu s drugim nalazima (22,24,30) u kojima je istaknuto da su lingvalne površine gornjih molara područja na kojima se najčešće gubi pečaćenje. Moguće objašnjenje jest da je teško postaviti materijal i na vrijeme ga polimerizirati zbog posteriornog položaja u usnoj šupljini, težeg osvjetljavanja te učinka gravitacije. Osim toga, pedodonti i većina studenata u ovom istraživanju, bili su dešnjaci te im lingvalne fisure na desnoj strani nisu tako pregledne. Djeca su uglavnom bili dešnjaci te su bolje prali zube na lijevoj strani usne šupljine. Može se pretpostaviti da je glavni uzrok neuspjeha ljudska pogreška, a ne nedostaci u materijalu.

Iako to nije bila svrha našeg istraživanja, ustanovili smo jedinstven nalaz da su kod jednog pacijenta s visokim rizikom, zubi koji nisu pečaćeni trostruko skloniji karijesu od pečaćenih. Budući da je uzorak mali, potrebne su daljnje analize.

Također smo ustanovili da je trebalo ponoviti pečaćenje uglavnom onih zuba koji su u razdoblju pečaćenja bili djelomice izrasli. Budući da nije prihvatljivo čekanje da zubi niknu do kraja, pa da se tek tada pečate, posebice kod pojedinaca sklonih karijesu, dobra je alternativa materijal GC Fuji TRIAGE™ za pečaćenje djelomice izniknutih zuba (12).

Klinički uspjesi materijala za pečaćenje na intaktnim i ponovno zapečaćenim trajnim zubima ko-

played the most pivotal role. It is widely accepted that small carious lesions can be sealed and prevented from further expansion (17, 29). However, there are reports consistent with the experience of the first author, that carious development can occur under apparently intact sealants (22, 24, 31). In our experience in the teaching and private facilities, many carious lesions were detected by slightly opening pit and fissures. The lesions were then properly dealt with through preventive resin restorations instead of sealants alone. Mechanical preparation significantly contributes to higher sealant retention rates in a clinical setting (28) and to a low level of microleakage in the laboratory (9, 15). This alternative is the best suited to avoid the “seal it in” approach.

Generally, most resealing and restoration at SPEC and PP occurred within the first three years (Figs. 3 and 4). This finding indicates that sealant maintenance is crucial for effective sealant treatment. The use of sealants in combination with other preventive procedures, such as application of topical fluoride, is most effective in caries prevention (1, 29), as practiced in SPEC and PP.

Our research further demonstrated that maxillary rather than mandibular teeth were more likely to require a restoration after the initial sealant placement. Primary second molars and permanent first molars on the right hand side were the teeth most likely to require restoration. This was consistent with other research findings (22, 24, 30) where it was indicated that the lingual surfaces of maxillary molars are notorious for sealant loss. A possible explanation for this finding is that it is difficult to place the sealant and cure it in a timely fashion, due to the posterior position of the maxillary molars in the oral cavity, an imperfect lighting system for curing, and the effect of gravity. Furthermore, the paediatric dentists and most of the students in this study were right handed and thus lingual grooves of molars in the first quadrant were not as easily seen during the procedure. Also, most of the children were right handed and thus brush better on the left side of their mouths. It can be speculated that human error is the major cause for failure rather than material deficiencies.

While it was not the focus of the study, a unique finding was that teeth that were not sealed were three times more caries prone than sealed teeth in the same high-risk patients. Such results strongly suggest that sealants are effective tools in caries prevention for high-risk patients. As the sample size was small for this finding (72 teeth), further study is recommended.

je su tretirali studenti i pedodonti, bili su u skladu s laboratorijskim nalazima. To bi trebalo potvrditi kliničarima da laboratorijska istraživanja mogu biti dobri prediktori kliničkog ponašanja materijala.

Zaključci

- 1) Studenti stomatologije bili su uspješni gotovo kao pedodonti u primjeni materijala za pečaćenje jamica i fisura kod djece;
- 2) Pažljivom primjenom tehnika pečaćenja, održavanjem, ponovnim pečaćenjem trajnih i mliječnih zuba te primjenom drugih preventivnih mjera, moguće je održati 96% djece bez karijesa;
- 3) Pečaćeni prvi trajni molari kod istog pacijenta s visokim rizikom tri puta su manje osjetljivi na karijes od nepečaćenih;
- 4) Usporedivi rezultati istraživanja s istim materijalom u kliničkom radu i laboratorijskim uvjetima upućuju na to da takva istraživanja mogu biti dobar prediktor kliničkih rezultata. Zato se laboratorijska istraživanja preporučuju prije kliničkih.

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It was also found that the teeth that required sealant replacement were most often those that were only partially erupted at the time of placement. As waiting for teeth to fully erupt to place sealant is not a viable option in caries-susceptible individuals, vigorous maintenance is recommended. Materials such as GC Fuji TRIAGE™ could be good alternatives for sealing partially erupted teeth (12).

The clinical successes of sealant use as seen in intact and resealed non-carious permanent teeth placed by both paediatric dentists and students compared well with laboratory findings. This finding should give some reassurance to clinicians that laboratory studies can be good predictors of the clinical behaviour of materials.

Conclusion

- 1) Dental students were nearly as successful in applying pit and fissure sealant on child patients as paediatric dentists.
- 2) With meticulous application of techniques in sealing, maintenance by resealing of permanent and primary teeth, and application of other preventive measures, 96% of children can be kept caries free.
- 3) Sealed first permanent molars are three times less susceptible to caries than unsealed molars in the same high risk patient.
- 4) The comparable results of the study of the same material in the clinic and laboratory suggest that a laboratory study can be a very good predictor of clinical results. Laboratory studies are therefore strongly recommended before clinical study.

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Abstract

Background: Pit and fissure sealants are widely researched in laboratory and clinical trials. Both experienced paediatric dentists as well as student dentists often use sealants as a preventive measure in paediatric dentistry. **Objectives:** 1. Compare the outcomes of pit and fissure sealants applied to primary and permanent dentitions by students and paediatric dentists; 2. Compare the outcomes of sealants placed in clinical and laboratory settings. **Materials and Methods:** Data were collected for 6871 sealants placed during a five year period, from patient charts at a private paediatric clinic (PP) and a student teaching facility, Simulated Practice Environment Clinic (SPEC) at Schulich Dentistry, The University of Western Ontario, London, Canada. Sealed teeth were identified as intact, lost sealant, or carious. **Results:** Statistical analysis using the Chi-square test was performed. Of all the sealants placed by students and dentists, after five years, 88.6% were intact, 7.2% were partially or totally lost and 4.1% had caries. There was no significant difference ($p > 0.05$) in the performance of paediatric dentists and students on primary teeth. There was statistically significant difference ($p < 0.01$) but no clinical difference between dentists and students in the treatment of permanent teeth. The laboratory success of 95% corresponded well with the clinical success of 93.5% and 98.4% caries free permanent teeth, performed by students and dentists, respectively. **Conclusions:** 1. After five years, 96% of sealed and resealed teeth stayed caries free. 2. Laboratory studies can be good predictors of how sealant materials may perform *in vivo*.

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Key words

Dental Fissures; Pit and Fissure Sealants; Prevention; Students

References

- Hicks MJ, Flaitz CM. Pit and Fissure Sealants and Conservative Adhesive Restorations: Scientific and Clinical Rationale. In: Pinkham JR, editor. Paediatric Dentistry: infancy through adolescence. 4th ed. St. Louis, Missouri: Elsevier Saunders; 2005. p. 520-68.
- American Academy of Pediatric Dentistry Council on Clinical Affairs. Policy on use of a caries-risk assessment tool (CAT) for infants, children, and adolescents. *Pediatr Dent*. 2005;2006;27 Suppl 7:25-7.
- Psoter WJ, Zhang H, Pendry DG, Morse DE, Mayne ST. Classification of dental caries patterns in the primary dentition: a multidimensional scaling analysis. *Community Dent Oral Epidemiol*. 2003;31(3):231-8.
- Duangthip D, Lussi A. Variables contributing to the quality of fissure sealants used by general dental practitioners. *Oper Dent*. 2003;28(6):756-64.
- Summitt JB. Field isolation. In: Summitt JB, Robbins JW, Hilton TJ, Schwartz RS, dos Santos J Jr., editors. Fundamentals of operative dentistry: a contemporary approach. Chicago: Quintessence Publishing; 2006. p. 156-82.
- Muller-Bolla M, Lupi-Pégurier L, Tardieu C, Velly AM, Antomarchi C. Retention of resin-based pit and fissure sealants: A systematic review. *Community Dent Oral Epidemiol*. 2006;34(5):321-36.
- Albani F, Ballesio I, Campanella V, Marzo G. Pit and fissure sealants: results at five and ten years. *Eur J Paediatr Dent*. 2005;6(2):61-5.
- Primosch RE, Barr ES. Sealant use and placement techniques among pediatric dentists. *J Am Dent Assoc*. 2001;132(10):1442-51.
- Hatibovic-Kofman S, Wright GZ, Braverman I. Microleakage of sealants after conventional, bur, and air-abrasion preparation of pits and fissures. *Pediatr Dent*. 1998;20(3):173-6.
- Lupi-Pégurier L, Bertrand MF, Genovese O, Rocca JP, Muller-Bolla M. Microleakage of resin-based sealants after Er:YAG laser conditioning. *Lasers Med Sci*. 2007;22(3):183-8.
- Stavridakis MM, Favez V, Campos EA, Krejci I. Marginal integrity of pit and fissure sealants. Qualitative and quantitative evaluation of the marginal adaptation before and after *in vitro* thermal and mechanical stressing. *Oper Dent*. 2003;28(4):403-14.
- Knight G. The fissure seal time bomb. *Dental Town Magazine*. 2002;(7):23.
- Hebling J, Feigal RJ. Use of one-bottle adhesive as an intermediate bonding layer to reduce sealant microleakage on saliva-contaminated enamel. *Am J Dent*. 2000;13(4):187-91.
- Feigal RJ, Quelhas I. Clinical trial of a self-etching adhesive for sealant application: success at 24 months with Prompt L-Pop. *Am J Dent*. 2003;16(4):249-51.
- Hatibovic-Kofman S, Butler SA, Sadek H. Microleakage of three sealants following conventional, bur, and air-abrasion preparation of pits and fissures. *Int J Paediatr Dent*. 2001;11(6):409-16.
- Kersten S, Lutz F, Schüpbach P. Fissure sealing: optimization of sealant penetration and sealing properties. *Am J Dent*. 2001;14(3):127-31.
- Simonsen RJ. Pit and fissure sealant: review of the literature. *Pediatr Dent*. 2002;24(5):393-414.
- Adair SM. The role of sealants in caries prevention programs. *J Calif Dent Assoc*. 2003;31(3):221-7.
- Hiiri A, Ahovuo-Saloranta A, Nordblad A, Mäkelä M. Pit and fissure sealants versus fluoride varnishes for preventing dental decay in children and adolescents. *Cochrane Database Syst Rev*. 2006;(4):CD003067.
- Mejàre I, Lingström P, Petersson LG, Holm AK, Twetman S, Källestål C et al. Caries-preventive effect of fissure sealants: a systematic review. *Acta Odontol Scand*. 2003;61(6):321-30.
- Folke BD, Walton JL, Feigal RJ. Occlusal sealant success over ten years in a private practice: comparing longevity of sealants placed by dentists, hygienists, and assistants. *Pediatr Dent*. 2004;26(5):426-32.
- Cline JT, Messer LB. Long term retention of sealants applied by inexperienced operators in Minneapolis. *Community Dent Oral Epidemiol*. 1979;7(4):206-12.
- Simonsen RJ. Retention and effectiveness of dental sealant after 15 years. *J Am Dent Assoc*. 1991;122(10):34-42.

24. Wendt LK, Koch G, Birkhed D. On the retention and effectiveness of fissure sealant in permanent molars after 15-20 years: a cohort study. *Community Dent Oral Epidemiol.* 2001;29(4):302-7.
25. Richardson BA, Smith DC, Hargreaves JA. A 5-year clinical evaluation of the effectiveness of a fissure sealant in mentally retarded Canadian children. *Community Dent Oral Epidemiol.* 1981;9(4):170-4.
26. Boksmán L, McConnell RJ, Carson B, McCutcheon-Jones EF. A 2-year clinical evaluation of two pit and fissure sealants placed with and without the use of a bonding agent. *Quintessence Int.* 1993;24(2):131-3.
27. Shapira J, Eidelman E. The influence of mechanical preparation of enamel prior to etching on the retention of sealants: three-year follow-up. *J Pedod.* 1984;8(3):272-7.
28. Klingberg G, Dahllöf G, Erlandsson AL, Grindefjord M, Hallström-Stalin U, Koch G et al. A survey of specialist paediatric dental services in Sweden: results from 2003, and trends since 1983. *Int J Paediatr Dent.* 2006;16(2):89-94.
29. Källestål C. The effect of five years' implementation of caries-preventive methods in Swedish high-risk adolescents. *Caries Res.* 2005;39(1):20-6.
30. Kim TTY, Gamboa K, Hatibovic-Kofman S. Five-year retrospective study of composite vs. amalgam in primary molars. *J Dent Res.* 2006;85(Spec Iss A):Abstract #0364. AADR 35th Annual Meeting in Orlando, Florida.
31. Bader JD, Shugars DA. The evidence supporting alternative management strategies for early occlusal caries and suspected occlusal dentinal caries. *J Evid Based Dent Pract.* 2006;6(1):91-100.
32. Beirut N, Frencken JE, van't Hof MA, Taifour D, van Palenstein Helderma WH. Caries-preventive effect of a one-time application of composite resin and glass ionomer sealants after 5 years. *Caries Res.* 2006;40(1):52-9.