Brtvljenje materijala za retrogradno punjenje korijenskih kanala

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Acta Stomatol Croat
1998; 295—299

Sažetak

U radu je in vitro ispitano brtvljenje materijala za retrogradno punjenje korijenskih kanala: amalgama, Super EBA-cementa i IRM-a. Korijenski kanali trideset i četiriju jednokorijenskih zuba obrađeni su "step-back" tehnikom i punjeni tehnikom hladne lateralne kondenzacije. Vršci su korijena resecirani i izrađeni su retrogradni kaviteti I razreda dubine 2 mm. Skupine po 10 zuba punjene su jednim od navedenih materijala. Nakon sedam dana u boji uzorci su podvrgnuti procesu bistrenja. Prozirnost zuba postignuta je demineralizacijom u dušičnoj kiselini, dehidracijom u etilnom aloholu i uranjanjem zuba u metil-salicilat. Prodor boje očitan je stereomikroskopom. Temeljem dobivenih rezultata najbolje retrogradno brtvljenje postignuto je EBA-cementom, a amalgam i IRM pokazali su slabiju sposobnost brtvljenja.

Ključne riječi: *retrogradno punjenje, brtvljenje, amalgam, Super-EBA, IRM.*

IZVORNI ZNANSTVENI RAD
Primljeno: 8. prosinca 1997.

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Uvod

Endodontska kirurgija indicirana je kada nije moguće ortogradno liječiti zub. Cilj je kirurškoga liječenja ukloniti bolesno tkivo i zabrtviti korijenski kanal.

Prema Weinu (1) najčešći uzrok neuspjeha endokirurških zahvata jest nepotpuno zatvaranje vrška korijena. Iako postoje mnogobrojni materijali za retrogradno punjenje korijenskih kanala (2-4), ni jedan ne osigurava idealno brtvljenje vrška korijena. Amalgam je najčešće rabljeni materijal, no na temelju studija *in vitro* pokazalo se je da je rubno popuštanje amalgama veće u odnosu spram drugih materijala (5,6) vjerojatno zbog toga što se ne može vezivati za dentin (7). U novije vrijeme za retrogradno punjenje preporučuju se materijali na bazi cink-oksida, kao što su IRM i Super EBA. Razna ispitivanja pokazala su da Super EBA cement ima najmanje propuštanje u usporedbi s drugim materijalima za retrogradno punjenje (2,8,9). Na temelju raznih studija *in vitro* (2,4) IRM se je također pokazao otpornim na rubno popuštanje.

Svrha rada bila je utvrditi i usporediti kakvoću brtvljenja amalgama, Super EBA cementa i IRM-a na temelju kvantitativnoga prodora boje.

Materijal i postupak

Eksperimentalni uzorak činila su 34 jednokorijenska zuba. Nakon mehaničkoga čišćenja zubi su

sterilizirani u autoklavu i pohranjeni u sterilnu fiziološku otopinu. Dužina korijenskoga kanala utvrđena je Kerr razvrtačem br. 15 (ISO # 15) (Maillefer, Ballaigues, Švicarska). Kada je vrh instrumenta prodro kroz apeksni otvor, instrument je uvučen 1 mm. Dobivena dužina predstavljala je radnu duljinu. Korijeni su mehanički obrađeni "step-back" tehnikom uz ispiranje 2,5% otopinom NaOCl.

Svi kanali obrađeni su do internoga foramena Kerr razvrtačem br. 40 (ISO # 40), koronarna trećina obrađena je do Kerr razvrtača br. 80 (ISO # 80). Otvor korijenskih kanala proširen je Gates-Glidden svrdlima (Maillefer, Ballaigues, Švicarska) br. 3 i 4. Nakon mehanièke obradbe uzorci su isprani 2,5% otopinom NaOCl, osušeni mlazom zraka i papirnim štapićima, te punjeni gutaperkinim štapićima, i Diaket punilom, tehnikom hladne lateralne kondenzacije. Trepanacijski otvori na svim uzorcima ispunjeni su cinkoksifosfatnim cementom (Harvard, Berlin, Njemačka). Uzorci su uronjeni u fiziološku otopinu i stavljeni u termostat na 37 °C dok se materijal nije posve stvrdnuo. Vršci korijena resecirani su fisurnim brusilom, pod kutem od 20^0 spram uzdužne osi zuba. Zatim su retrogradni kaviteti I. razreda izvrtani fisurnim čeličnim svrdlom do dubine od 2 mm. Kontrolnoj skupini od četri zuba reseciran je vršak korijena bez retrogradnog kaviteta.

Zubi su slučajnim odabirom podijeljeni u tri skupine s po deset zuba svaka. Materijali za punjenje zamiješani su prema preporuci proizvođača. Prva skupina punjena je s amalgamom (Espe, Seefeld, Njemačka), druga skupina punjena je s Super EBA cementom (Optow EBA cement; Teledyne Getz, Elk Grove Village, IL, USA), a treća skupina punjena je IRM-om (L.D: Caulk, USA).

Nakon sedam dana stvrdnjavanja u fiziološkoj otopini cijela je površina zuba, osim 2 mm uokrug apeksnog otvora, premazana dvama slojevima izolacijskoga laka (obojeni lak za nokte). Svaki je zub pojedinačno stavljen u kušalicu uz dodatak boje (Drawing ink blue - Rotring, GmbH, Hamburg, Njemačka) tijekom sedam dana. Uzorci su isprani mlazom tekuće vode i lak je odstranjen skalpelom. Zatim je izveden postupak "bistrenja" demineralizacijom zuba u 5% dušičnoj kiselini 24 sata, dehidracijom u 80% etilnom alkoholu 24 sata, u 90% etilnom alkoholu tri puta po 1 sat, i u 100% etilnom alkoholu 1 sat. Naposljetku, uzorci su uronjeni u metilsalicilat. Stereomikroskopom (Zeiss/SV6, Njemačka) očitan je kvantitativni prodor boje i izražen u stupnjevima:

stupanj 0 - nema prodora boje,

stupanj 1 - boja prodrla do 1/3 retrogradnoga punjenja,

stupanj 2 - boja prodrla do 2/3 retrogradnoga punjenja,

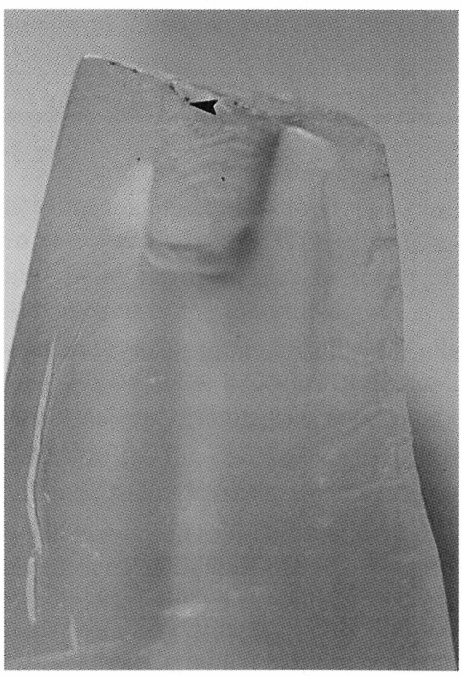
stupanj 3 - boja prodrla cijelom dužinom retrogradnoga punjenja,

stupanj 4 - boja prodrla između gutaperke i stijenke kanala.

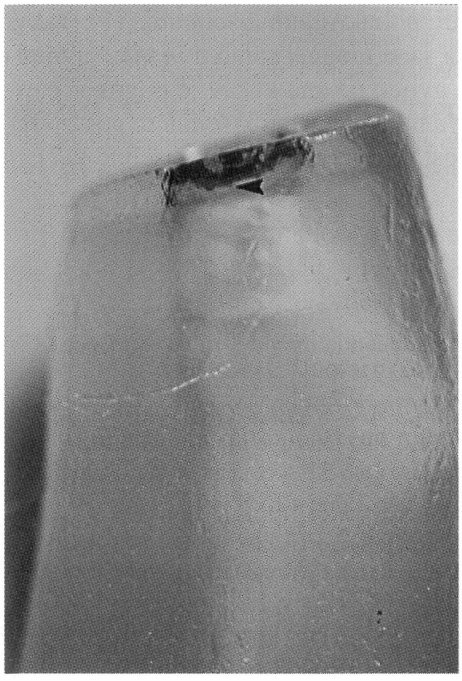
Kalibriranom skalom na okularu dobiveni su podatci u m temelju kojih su izračunane su srednje vrijednosti, a statistička obradba izvršena je Studentovim *t* testom.

Rezultati

Prema dobivenim rezultatima najmanji je prodor boje izmjeren u uzoraka punjenih Super-EBA cementom. Srednja vrijednost iznosila je 4,4 mm i s.d. 4,3, a IRM je pokazao slabije brtvljenje. Srednja

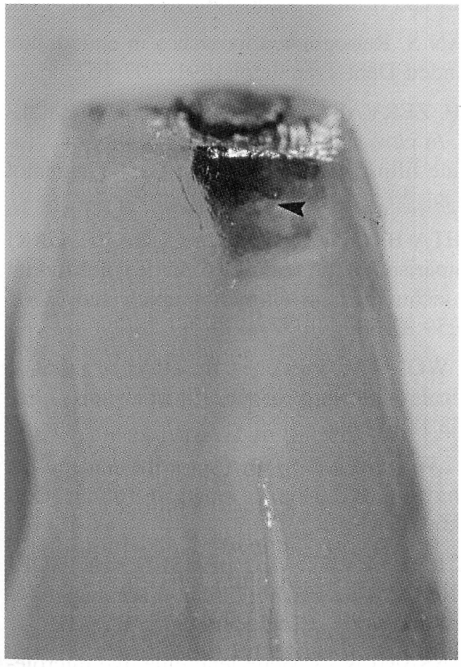


Slika 1. Retrogradno punjenje Super EBA cementom (strjelica-stupanj 1)
Figure 1. Retrograde filling with Super EBA cement (arrow-degree 1)



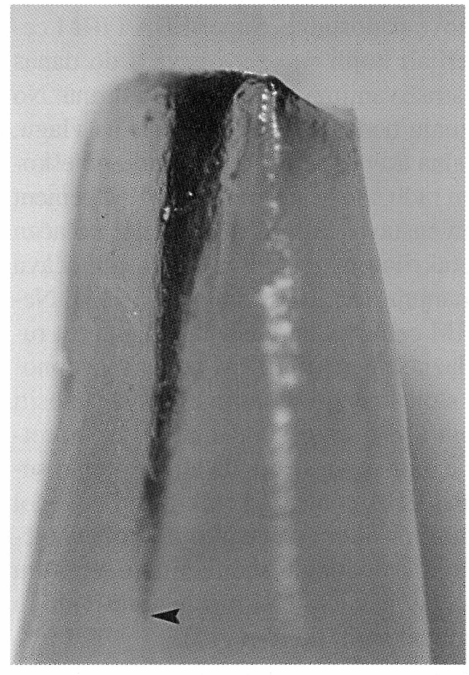
Slika 2. Retrogradno punjenje IRM-om (strjelica-stupanj 2)
Figure 2. Retrograde filling with IRM (arrow-degree 2)

vrijednost IRM-a bila je 8.6 μm i s.d. 5,3. Amalgam je pokazao najslabiju sposobnost brtvljenja uz srednju vrijednost 10,6 μm i s.d. 3,4. Statističke ra-



Slika 3. Retrogradno punjenje amalgamom (strjelica-stupanj 3)
Figure 3. Retrograde filling with amalgam (arrow-degree 3)

ščlambe pokazale su statistički vjerodostojno veći prodor boje u uzoraka punjenih amalgamom nego onih Super EBA cementom (p>0.05). Na Slici 1. vidljiv je neznatan prodor boje kod Super EBA cementa (stupanj 1). Kod IRM cementa utvrđen je prodor boje do 2/3 retrogradnoga punjenja, što je vidljivo na Slici 2. (stupanj 2), dok je kod amalgama boja prodrla cijelom dubinom retrogradnog punjenja (stupanj 3)(Slika 3). Zabilježena je statistički vjerodostojna razlika između svih ispitivanih materijala i uzoraka kontrolne skupine. Kod svih uzoraka kontrolne skupine boja je prodrla između gutaperke i stijenke kanala, što je vidljivo na Slici 4.



Slika 4. Kontrolna skupina - prodor boje kroz punjenje između stijenke korijenskog kanala i punjenja
Figure 4. Control groups- dye leakage through root filling and root wall

Rasprava

Objavljeni su mnogobrojnim radovi kojima se ispitivala kakvoća brtvljenja raznih materijala, kao amalgama, Super EBA cementa, IRM-a, Cavita i kompozita.

Bondra i sur. (2) smatraju da svi cementi temeljeni na cink-oksidu bolje brtve korijenski kanal u usporedbi s amalgamom. Čini se da je kakvoću

brtvljenja amalgamom moguće povežati nanošenjem jednog ili dva sloja laka na stijenke korijenskoga kanala prije nego što se materijal unese u kavitet (10). Osim toga postoje razlike u brtvljenju između pojedinih vrsta amalgama. Nelson i Mahler (11) su, primjerice pronašli da se amalgami s visokim udjelom bakra počnu skvrčavati tri mjeseca pošto su uneseni u kavitet. Amalgami s dodatkom cinka zbog svoje kasne ekspanzije bolje brtve i kompenziraju skvrčavanje, ali kako im se naknadno povećava volumen mogu prouzročiti puknuće korijena. U jednom istraživanju Moodnik i sur. (12) dokazali su postojanje pukotina između amalgama i prepariranoga kaviteta veličine 6 do 150 μm. Zato se amalgam nastoji zamijeniti drugim materijalima koji bi kompenzirali njegove nedostatke. Super EBA i IRM cement su materijali kojih su se svojstva u do danas objavljenim istraživanjima pokazala najboljima. No i ti cementi imaju nedostatke: osjetljivost na vlagu, podražuju vitalna tkiva, topljivi su, stvaraju poteškoće u kliničkom radu s materijalom (13). IRM cement je po svojemu sastavu cink-oksid eugenol pojačan polimetil metakrilatom - smolom koja povećava čvrstoću i smanjuje topljivost materijala (14). Nedostatak je IRM cementa ograničena mogućnost rukovanja. U vlažnome mediju IRM nema sposobnost svezivanja slojeva nego se mora u kavitet unositi u jednom sloju i vrlo brzo kondenzirati. U suprotnome područje rada mora se održavati apsolutno suhim (14). Super EBA cement je cink-oksid eugenol pojačan aluminij oksidom s dodatkom ortobenzoične kiseline koja omogućuje redukciju eugenola u materijalu i na taj ga način čini manje agresivnim u doticaju s periapeksnim tkivom (15).

Prednost EBA cementa u odnosu prema IRM-u jest u lakšem rukovanju. Ima sposobnost svezivanja u vlažnome mediju i može se dodavati u slojevima (14). Super EBA cement u našem je radu, kao i u još nekim do sada objavljenim radovima (11,16), pokazao nešto bolju kakvoću brtvljenja od IRM cementa no te razlike nisu statistički vjerodostojne.

Ipak Super EBA i dalje zadržava prednost pred IRM cementom zbog njegova lakšeg rukovanja i unošenja u kavitet, pogotovo u vlažnome mediju. No, bez obzira na bolju kakvoću brtvljenja od amalgama, Super EBA također nema sposobnost adhezije na dentin, to jest sposobnost kemijskog svezivanja za njega (17). Taj se nedostatak može ispraviti ako se dentin, prije nego što se unese Super EBA cement, obradi poliakrilnom kiselinom (17). Takvi su postupci za sada mogući samo u *in vitro* uvijetima jer se još uvijek ne zna kakav je odgovor periapeksnog tkiva na poliakrilnu kiselinu te postoji realna mogućnost agresivnog učinka kiseline (17).

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Leakage of Root-End Filling Materials

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Acta Stomatol Croat
1998; 301—303

Summary

The in vitro quality of the sealing ability of materials for retrograde root fillings: amalgam, Super EBA-seal and IRM has been examined.

The root canals of thirty four single rooted teeth were treated by conventional "step-back" technique and obturated by gutta-percha and Diaket sealer using cold lateral condensation technique.

The apex of the roots were resected and retrograde cavities of Class I, 2 mm deep, were made. Three groups of 10 samples each were obturated by one of the mentioned materials. After seven days in ink the samples underwent the "clearing" process.

The transparency of teeth was achieved by demineralization in nitric acid, dehidration in ethyl alcohol and by submerging the teeth in methyl-salicilat. The linear day penetration was measured by means of a stereomicroscope. On the basis of the obtained results, in this study, the best retrograde sealing was achieved by using EBA-cement while amalgam and IRM showed poorer sealing ability.

Key words: *retrograde filling, sealing ability, amalgam, Super EBA, IRM*

ORIGINAL SCIENTIFIC PAPER
Received: December 8, 1997

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Introduction

Endodontic surgery is indicated when conservative treatment of a tooth is not possible. The aim of the surgical treatment is to remove pathological tissue and to seal the apex.

According to Weine (1) the most common cause of endodontic failure is incomplete obturation of the root canal space. Although there are numerous materials for retrograde filling of root canals (2-4) , none of them provides the ideal apical seal. Amalgam is the most used material but studies *in vitro* have shown that microleakage is higher in comparison with other materials (5,6) probably because of the impossibility of bonding to dentin (7). Among others, materials based on zinc-oxide such as IRM and Super-EBA have been suggested. Various investigations have reported that Super EBA shows the least leakage compared to other materials for retrograde filling (2,8,9). IRM has also proved itself to be resistant to microleakage in various research *in vitro* (2,4).

The purpose of this study was to determine and compare the sealing ability of amalgam, Super EBA cement and IRM-a on the basis of linear dye penetration.

Materials and Methods

A sample of 34 single rooted teeth were used for the experiment. After mechanical cleaning the teeth were sterilized by autoclaving at a temperature of 120 °C and pressure of 300 kPa. Folowing sterilization, samples were submerged into a sterile physiological solution.

The working length was determined by introducing Kerr reamers #15 (Maillefer, Ballaigues, Switzerland) into the canal. When the point of the instrument penetrated through the apex, the instrument was withdraun for 1 mm. The roots were mechanically treated by conventional "step-back" technique accompanied by rinsing with 2.5% NaOCl. The apical portion of the root canal was prepared to a #80 K-file. The "step-back" procedure was then accomplished with Gates Glidden drills (Maillefer, Ballaigues, Switzerland). After the mechanical treatment all the samples were once again rinsed with 2.5% solution of NaOCl, and dried with air and paper points. All the samples were obturated with gutta-percha points and Diaket sealer (Espe, Seefeld, Germany) using the lateral condensation technique. Access opening of all samples were closed with zinc-oxside phosphate cement (Harvard, Berlin, Germany).

The samples were then stored in a physiological solution and placed into the thermostat at 37 °C. Seven days later the teeth were taken out and air dried. Apicoectomy of all samples was performed by removing 2 to 3 mm of the apical part, using fisure bur at an angle of 25° against the longitudinal axis of the tooth. The retrograde cavity was drilled using still fisure bur. The preparation depth was about 2 mm. In the control groups of four teeth only the root apex was resected.

The roots were randomly divided into three groups with ten samples each.

The filling materials were mixed according to the manufacturersí instructions. The first group of samples was filled with amalgam (Espe, Seefeld, Germany). The second group was filled with Super EBA cement (Optow EBA cement; Teledyne Getz, Elk Grove Village, IL, USA) and the third group was filled with IRM cement (L.D: Caulk, USA).

After seven days in the physiological solution, the whole surface of the tooth apart from 0,5 mm around the edge of the cavity, was covered with two layers of nail varnish. After which, each tooth was separately stored in a test tube filled with ink (Drawing ink blue - Rotring, GmbH, Hamburg, Germany) for seven days. The level of the ink in the test tubes was controlled every day and added to when necessary. After seven days, the teeth were rinsed in running water and the varnish removed by a scalpel. The clearing procedures consisted of placing the roots in 5% nitric acid for 24 hours, following by dehydration of the samples by successive immersion into 80% of ethyl alcohol over 24h. Dehydration process was completed by immersion of the samples in 90% alcohol for one hour and in absolute alcohol. Absolute alcohol was changed three times, after each hour. Finally, the roots were stored in methyl salicylate to complete the clearing process. The linear penetration was measured by means of a stereomicroscope (Zeiss/SV6, Germany) and calibrated scale.

The depth of the dye penetration was scored as follows:

degree 0 - no dye penetration,

degree 1 - the dye penetrated to 1/3 of the cavity,

degree 2 - the dye penetrated to 2/3 of the cavity,

degree 3 - the dye penetrated along the whole length of the cavity,

degree 4 - the dye penetrated between gutta-percha and the canal walls.

The mean values of linear microleakage were calculated and statistical analysis was done by Student's t-test.

Results

The results showed that Super EBA cement filled samples showed the least dye penetration. The mean value was 4.4 μm and s.d. 4.3. The mean value of dye penetration of IRM was 8.6 μm and s.d. 5.3. Amalgam showed the least sealing ability. The