UDC: 616.314.163-089.818L ISSN 0039-1743 COBISS. SR-ID 8417026

Efekat različitih tehnika irigacije na kvalitet čišćenja zidova kanala korena zuba

DOI: 2298/SGS0804221P

The effect of different irrigation techniques on the quality of cleaning of root canal walls

Violeta Pavlović, Slavoljub Živković
Klinika za Bolesti zuba i endodonciju, Stomatološki fakultet u Beogradu
Department of Restorative Dentistry and Endodontics, School of Dentistry, University of Belgrade

ORGINALNI RAD (OR)
ORIGINAL ARTICLE

KRATAK SADRŽAJ

Cilj *ovog istraživanja je bio da se SEM analizom proveri efekat tehnike irigacije, odnosno primene različitih vrsta igala za irigaciju, na kvalitet čišćenja zidova tokom preparacije kanala korena zuba.*

Materijal i metod*: Istraživanje je obavljeno na 16 ekstrahovanih, jednokorenih, humanih zuba.Uzorci su podeljeni u dve eksperimentalne grupe u odnosu na vrstu igle korišćene za irigaciju. Za ispiranje uzoraka prve grupe korišćena je konvencionalna igla, a za ispiranje uzoraka druge grupe igla sa lateralnim perforacijama. Svi kanali su instrumentirani K turpijama i primenom Step back tehnike preparacije.Tokom instrumentacije, svi uzorci su ispirani 2,5% rastvorom NaOCl-a, a po završenoj instrumentaciji sa 17 % rastvorom EDTA tokom 1 minuta. Na kraju su svi uzorci isprani sa još 10 ml destilovane vode. Korenovi svih zuba su potom presecani uzdužno i srednje trećine kanala posmatrane SEM-om. Za kvantitativnu procenu korišćeni su kriterijumi Hülsmann-a i sar.*

Rezultati*: Dobijeni rezultati su pokazali da je u grupi uzoraka ispiranih lateralno perforiranom iglom postignuto efikasnije uklanjanje debrisa i razmaznog sloja sa zidova kanala korena nego u grupi uzoraka ispiranih konvencionalnom iglom. Razlika u rezultatima izmedju ispitivanih tehnika irigacije bila je statistički značajna ($p<0,01$).*

Zaključak*: Primena lateralno perforirane igle za irigaciju obezbedjuje efikasnije čišćenje zidova kanala korena, odnosno efikasnije uklanjanje debrisa i razmaznog sloja.*

Ključne reči: tehnike irigacije, čišćenje, kanal korena

SUMMARY

Aim: *To evaluate the effect of irrigation techniques, i.e. different types of irrigation needles, on the quality of cleaning of root canal walls using scanning electron microscopy (SEM).*

Material and Method: *The study was conducted on 16 extracted, single-rooted, human teeth. The samples were allocated to two experimental groups depending on the type of the irrigation needle. Conventional needles were used for the irrigation of Group I and laterally perforated ones for Group II. All root canals were instrumented using K files and the Step-back technique. During instrumentation, all samples were irrigated with 2.5 % sodium hypochlorite solution followed by final irrigation with 17 % EDTA for 1 min. After that, all samples were irrigated with 10 ml of distilled water. The roots were, then, sectioned longitudinally and middle one third of each root canal was analysed using SEM. Quantitative analysis was based on criteria by Hülsmann et al.*

Results: *The obtained results showed that the more efficient removal of debris and the smear layer was accomplished in the group of samples irrigated using laterally perforated needles than conventional needles. The difference between the investigated irrigation techniques were statistically significant ($p<0.01$).*

Conclusion: *The use of laterally perforated needles for irrigation allows more efficient cleaning of root canal walls, i.e. the removal of debris and the smear layer.*

Keywords: irrigation techniques, cleaning, root canal.

Kompletno čišćenje, pravilno oblikovanog kanalskog sistema, smatra se jednim od osnovnih preduslova za dugoročan uspeh endodontskog tretmana.(1) Savremenim tehnikama instrumentacije moguće je postići optimalan oblik korenskih kanala i stvoriti uslove za trodimenzionalnu opturaciju čitavog kanalskog prostora.Medjutim, čišćenje kompletnog kanalskog sistema nije uvek jednostavno postići. Zbog kompleksne morfologije većine kanalskih sistema, ostaci pulpnog tkiva, mikroorganizmi i dentinski debris mogu zaostati u nepravilnostima kanala i posle temeljnih mehaničkih procedura.(2) S druge strane, sve tehnike instrumentacije, naročito mašinske, na instrumentiranim zidovima kanala korena stvaraju razmazni sloj (smear layer), različite debljiine, koji prekriva zidove kanala i zatvara otvore dentinskih tubula.(3)

Zbog ograničene efikasnosti instrumenata u čišćenju kanala korena, neophodno je tokom i posle mehaničkih procedura kanale ispirati odgovarajućim hemijskim agensima. Irigansi svojim fizičkim i hemijskim delovanjem, u zonama nedostupnim instrumentaciji, omogućavaju rastvaranje ostataka mekog i čvrstog tkiva i obezbedjuju njihovo uklanjanje.(2)

Kako nijedan do danas poznat rastvor ne ispunjava sve zahteve, tokom irigacije, a radi postizanja željenih efekata (redukcije broja mikrorganizama i adekvatnog čišćenja kanala korena), neophodno je koristiti najmanje dva irigansa. Kombinacija rastvora NaOCl-a (0,5-5, 25%) i EDTA (15-17%) je najčešće primenjivan irigacioni protokol tokom endodontskog zahvata.Primena NaOCl-a obezbedjuje redukciju mikroorganizama i rastvaranje organskog tkiva u kanalu korena,dok EDTA, kao helatni agens, svoje delovanje ispoljava na neorganskom sadržaju, i značajno doprinosi uklanjanju dentinskog debrisa i razmaznog sloja sa zidova kanala korena.(4,5,6,7)

Za ispiranje kanala korena, pored konvencionalne tehnike putem šprica i igle, danas se koriste još ultrazvuk i laser.(8, 9) Najšire prihvaćen metod ipak je ispiranje kanala korena zuba pomoću šprica i igle. Osim konvencionalnih igala , za endodontsku primenu koriste se i igle sa lateralnim perforacijama. Prema navodima Goldman-a i sar., tehnika irigacije sa lateralno perforiranom iglom obezbedjuje efikasno dostavljanje irigansa u sve delove kanala korena,sprečava eventualno prebacivanje kanalnog sadržaja u periapeks i eliminiše debris efikasnije od konvencionalne igle za ispiranje kanala korena zuba.(10,11)

Cilj ovog rada je bio da se SEM analizom proveri efekat tehnike irigacije, odnosno efekat različitih igala za irigaciju na kvalitet čišćenja zidova kanala korena zuba.

Complete cleaning of adequately prepared root canal system is considered one of the main preconditions for the success of endodontic treatment.[1] Contemporary instrumentation techniques allow that an optimal shape of the root canal can be achieved as well as the preconditions for 3D obturation of the entire canal space. However, cleaning of the entire canal system is not always easy to achieve. Due to the complex morphology of most canal systems, pulp remnants, microorganisms and dentinal debris may remain in canal irregularities even after thorough mechanical procedures.[2] On the other hand, all instrumentation techniques, particularly rotary ones, create a smear layer of various thickness on the instrumented canal walls covering the orifices of dentinal tubules.[3]

Due to the limited efficiency of instruments in terms of root canal cleaning, it is mandatory to irrigate canals with adequate chemical agents during and after mechanical procedures. Irrigants promote dissolution and evacuation of soft and hard tissue remnants from those parts of the root canal which are inaccessible for instruments.[2]

Because none of the available solutions fulfils all requirements, it is necessary to use at least two irrigants during irrigation to achieve favourable effects (reduction in the number of bacteria and adequate root canal cleanliness).

The combination of NaOCl (0.5-5.25%) and EDTA (15-17%) is the most commonly used irrigation protocol during endodontic treatment. The use of NaOCl results in the reduction of microorganisms and dissolution of organic tissue in the root canal, whilst EDTA, as a chelator, affects the inorganic content and contributes significantly to the removal of dentinal debris and smear layer from root canal walls.[4-5]

Besides the conventional irrigation technique with a syringe and needle, ultrasonic and laser irrigation are also used in modern practice.[8,9] The most widely accepted method of irrigation is the syringe and needle. Besides conventional needles, laterally perforated ones are also used in endodontics. According to Goldmann et al. the irrigation technique with laterally perforated needles enables efficient delivery of the irrigant in all parts of the root canal, prevents periapical extrusion of the root canal content and eliminates debris more efficiently than conventional needles for root canal irrigation.[10,11]

The aim of the present study was to evaluate the effect of irrigation techniques, i.e. different types of irrigation needles, on the quality of cleaning of root canal walls during preparation using scanning electron microscopy (SEM).

Materijal i metod

Ispitivanja su izvedena u in vitro uslovima, na ekstrahovanim humanism zubima.Uzorak je obuhvatio 16 jednokorenih zuba koji su nakon ekstrahovanja do početka eksperimenta čuvani u fiziološkom rastvoru na 4C. Kod svih zuba pristupni kaviteti su preparisani visoko turažnom bušilicom i dijamantskim svrdlom. Za proveru inicijalne prohodnosti kanala i odredjivanje radne dužine kanalne preparacije (1 mm kraće od dužine na kojoj se vrh turpije pojavljuje na apeksu) korišćene su K turpije vel.10.Vrh korena svakog uzorka prekriven je roze voskom, da bi se simulirao apikalni kontra pritisak i sprečilo isticanje iriganasa kroz apikalni foramen tokom preparacije kanala korena. U odnosu na tehniku irigacije uzorci su podeljeni u dve grupe.U prvoj grupi (8 uzoraka) za ispiranje kanala korena korišćena je konvencionalna igla .U drugoj grupi (8 uzoraka) za ispiranje kanala korena korišćena je igla sa lateralnim perforacijama. Svi uzorci su instrumentirani turpijama tipa K i Step-back tehnikom do dimenzije 30 na radnoj dužini.Za ispiranje uzoraka korišćena je kombinacija iriganasa: 2,5% rastvor NaOCl-a i 17% rastvor EDTA. Tokom instrumentacije svi zubi su ispirani sa 2,5% rastvorom NaOCl-a u količini od 2 ml izmedju svakog instrumenta. Po završenoj instrumentaciji zubi su ispirani sa 5 ml 17% rastvora EDTA.Irigacija je realizovana tako što je 1ml rastvora ostavljen u kanalu korena tokom 1 minuta, a zatim je je kanal ispran sa preostala 4 ml istog rastvora. Svi zubi su zatim ispirani sa još 10 ml destilovane vode u cilju neutralizacije iriganasa.

Za ispiranje su korišćeni plastični špricevi zapremine 2 ml (tokom instrumentacije) i 5 ml (tokom finalnog ispiranja) i odgovarajuće igle (konvencionalna i lateralno perforirana) vel.27, savijene pod uglom od 30˚. Tokom irigacije svih uzoraka , igle su unošene u kanale što je moguće apikalnije, do osećaja blagog otpora, ali bez zaglavljivanja igle u kanalu korena. Irigacioni rastvor je aplikovan polako i bez pritiska uz konstantnu rotaciju igle za 120˚. Nakon toga krunice zuba su uklonjene dijamantskim diskom, korenovi uzdužno podeljeni i odabrane polovine pripremljene za posmatranje na SEM-u.Uzorci su posmatrani na JEOL JSM-840 Ä skening elektronskom mikroskopu. Fotomikrografije su napravljene u srednjoj trećini kanala korena kamerom Mamia 6x 9. Zidovi kanala korena su analizirani na uveličanjima x300 (za procenu debrisa) i x1000 (za procenu razmaznog sloja). Za kvantitativnu procenu prisustva debrisa i razmaznog sloja na zidovima kanala korena korišćeni su kriterijumi Hülsmann-a i sar.(1997)[12]

Material and Method

The study was done in vitro on 16 extracted human teeth. After extraction, the teeth were kept in saline at 4°C until the commencement of the experiment.

In all teeth, access cavities were prepared with a diamond bur in a high-speed hand piece. K files #10 were used for root canal exploration and working length determination (1 mm shorter than the length at which the file tip appeared at the apex). The root tip of each tooth was covered with pink wax to simulate the apical counter-pressure and prevent the irrigant from leaching out through the apical foramen during irrigation.

Based on the irrigation technique, all samples were allocated to two groups. In Group I (8 samples), conventional needles were used to irrigate root canals. In Group II (8 samples), irrigation was done using laterally perforated needles. All samples were instrumented with K files and the Step-back technique up to the file #30 at the tip. A combination of the following irrigants was used: 2.5% NaOCl and 17% EDTA. During instrumentation, all teeth were irrigated with 2 ml of 2.5% NaOCl between the two instruments. After the canals were completely instrumented, they were irrigated with 5 ml of 17% EDTA. This was done in such a way that 1 ml of the solution was left in situ for 1 min, followed by irrigation with the 4 ml of the same solution. All teeth were then flushed with 10 ml of distilled water to neutralise the irrigants.

Plastic 2 ml syringes were used for irrigation during instrumentation whilst 5 ml syringes were used for final flush with either conventional or laterally perforated needles, size #27 and 30° angulation. During irrigation of each sample, the needle was placed inside the root canal as much apically as possible until light resistance but without clenching in the canal. Irrigating solution was applied slowly without pressure and with constant 120° rotation of the needle.

After that, the crowns were cut off using a diamond disc, the roots were split longitudinally and selected halves were prepared for the SEM analysis. The samples were analysed under a JEOL JSM-840Ä scanning electron microscope. Photomicrographs were taken in middle one thirds of the root canals using a Mamia camera 6x9. Root canal walls were analysed under x300 magnification (debris assessment) and x1000 (smear layer assessment). Quantitative analysis of the debris and smear layer was based on criteria by Hülsmann et al. (1997).[12]

Kriterijumi za procenu debrisa:

Ocena 1. Zid kanala korena čist,sa samo nekoliko čestica debrisa
Ocena 2. Nekoliko malih konglomerata debrisa na zidu kanala
Ocena 3. Mnogo konglomerata debrisa prekriva manje od 50% zida kanala korena
Ocena 4. Više od 50% zida kanala korena prekriveno debrisom
Ocena 5. Ceo ili skoro ceo zid kanala korena prekriven debrisom

Kriterijumi za procenu razmaznog sloja:

Ocena 1. Nema razmaznog sloja,dentinski tubuli otvoreni
Ocena 2. Prisutna mala količina razmaznog sloja, otvoreno nekoliko dentinskih tubula
Ocena 3. Homogeni razmazni sloj prekriva zid kanala korena, otvoreno samo par dentinskih tubula
Ocena 4. Kompletan zid kanala korena prekriven homogenim razmaznim slojem, dentinski tubuli nisu otvoreni
Ocena 5. Obilan nehomogeni razmazni sloj prekriva kompletan zid kanala korena

Dobijeni rezultati statistički su obradjeni primenom Mann-Whitney U testa.

Rezultati

Rezultati SEM ispitivanja površine zida kanala korena posle različitih tehnika irigacije prikazani su u tabelama 1-2 i na fotografijama 1-4. U grupi uzoraka ispiranih konvencionalnom iglom,uočava se prisustvo čestica dentinskog debrisa različite veličine, rasutih po čitavoj površini zidova kanala korena u skoro svim uzorcima. Prosečna ocena dentinskog debrisa na analiziranim površinama je iznosila 2,75. Nakon irigacije lateralno perforiranom iglom dobijeni su čistiji zidovi kanala korena. Dentinski debris je skoro u celini uklonjen ili je prisutan u vidu malobrojnih partikula manjeg dijametra (10 μm).Prosečna vrednost dentinskog debrisa iznosila je 1,75. Statistička analiza (Mann-Whitney U test) je ukazala na postojanje značajne razlike u količini preostalog debrisa izmedju ispitivanih grupa ($p<0.01$).

U uzorcima ispiranim konvencionalnom iglom uočava se prisustvo razmaznog sloja na zidovima kanala korena. Površina prisutnog razmaznog sloja je mestimično diskontinuirana i uočavaju se otvori dentinskih kanalića. U uzorcima ispiranim lateralno perforiranom iglom razmazni sloj je skoro u potpunosti uklonjen i vidljivi su brojni otvori dentinskih kanalića.Prosečna vrednost razmaznog sloja na analiziranim površinama je iznosila 2,38 posle primene konvencionalne igle, odnosno 1,50 nakon primene lateralno perforirane igle.Uporedjivanjem prosečnih ocena prisutnog razmaznog sloja (Mann-Whitney U test) uočeno je da izmedju ispitivanih grupa postoji statistički značajna razlika ($p<0.01$).

Criteria for the debris assessment were:

Score 1. Canal wall clean with a few particles of debris.
Score 2. A few small conglomerates of debris on the canal wall.
Score 3. A lot of conglomerates of debris covering less than 50% of the canal wall.
Score 4. More than 50% of the canal wall covered with debris.
Score 5. Entire or almost entire canal wall covered with debris.

Criteria for the smear layer assessment were:

Score 1. No smear layer, dentinal tubules open.
Score 2. A small amount of the smear layer present, a few dentinal tubules open.
Score 3. Homogeneous smear layer covering the canal wall, a few dentinal tubules open.
Score 4. Entire canal wall covered with homogenous smear layer, dentinal tubules closed.
Score 5. Excessive non-homogeneous smear layer covering the entire canal wall.

The results were statistically analysed using Mann-Whitney U test.

Results

The results of this SEM study of the cleanliness of the root canal walls after different irrigation techniques are presented in Tables 1-2 and figures 1-4.

In Group I, where samples were irrigated with the conventional needle, we found various size particles of dentinal debris spread across the entire surface of almost all samples. The mean score for dentinal debris on analysed surfaces was 2.75. Cleaner canal walls were observed in Group II, where laterally perforated needles were used for irrigation. Dentinal debris was removed almost in its entirety or was present in the form of scarce particles of small diameter (10 μm). The mean score for dentinal debris was 1.75. Statistical analysis (Mann-Whitney U test) revealed a significant difference in the amount of the remaining debris between the two groups ($p<0.01$).

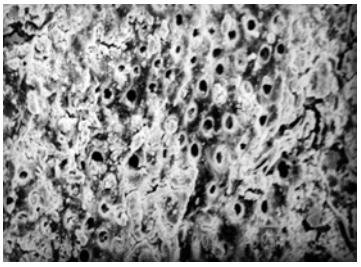
In Group I, the smear layer was observed on root canal walls. The surface of this smear layer was discontinued slightly with noticeable orifices of dentinal tubules. In Group II, the smear layer was almost entirely removed with many orifices of dentinal tubules visible. The mean score for the smear layer was 2.38 for the conventional needle and 1.50 for the laterally perforated one. Statistical analysis (Mann-Whitney U test) revealed a significant difference in the amount of the remaining smear layer between the two groups ($p<0.01$).

Tabela 1. *Kvantitativna procena debrisa.*
Table 1. *Quantitative assessment of debris.*

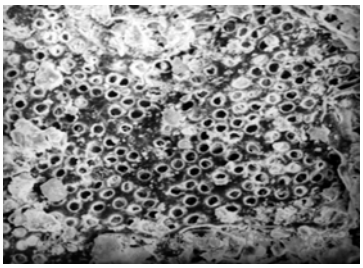
	N	Prosečna vrednost / Mean	Standardna devijacija / SD	Koeficijent varijacije / Coefficient of variation (%)	Mann Whitney U test
Konvencionalna igla/ Conventional needle	8	2.75	0.71	25.82	U=11.0
Lateralno perforirana igla/ Laterally perforated needle	8	1.75	0.71	40.57	p<0.01

Tabela 2. *Kvantitativna procena razmaznog sloja.*
Table 2. *Quantitative assessment of the smear layer.*

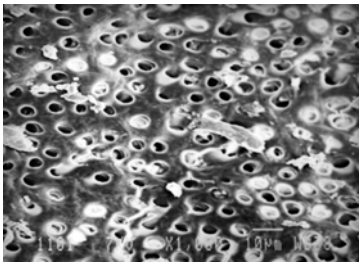
	N	Prosečna vrednost / Mean	Standardna devijacija / SD	Koeficijent varijacije / Coefficient of variation (%)	Mann Whitney U test
Konvencionalna igla/ Conventional needle	8	2.38	0.52	21.85	U=11.5
Lateralno perforirana igla/ Laterally perforated needle	8	1.50	0.76	50.67	p<0.01



Slika 1. *Površina zida kanala ispiranog konvencionalnom iglom (SEM x 1000). Debris prekriva više od 50% površine zida kanala korena (ocena 4), otvoreno samo par dentinskih tubula (ocena 3).*
Figure 1. *The surface of the canal wall of a sample irrigated with a conventional needle (SEM x 1000). More then 50% of the root canal wall covered with debris (score 4), only a few dentinal tubules open (score 3).*



Slika 2. *Površina zida kanala ispiranog konvencionalnom iglom (SEM x 1000). Debris prekriva manje od 50% površine zida kanala korena (ocena 3), uočavaju se otvori dentinskih tubula (ocena 2).*
Figure 2. *The surface of the canal wall of a sample irrigated with a conventional needle (SEM x 1000). Less then 50% of the root canal wall covered with debris (score 3), the orifices of dentinal tubules visible (score 2).*



Slika 3. *Površina zida kanala ispiranog lateralno perforiranom iglom (SEM x 1000). Na zidu kanala uočava se nekoliko manjih konglomerata debrisa (ocena 2), prisutna mala količina razmaznog sloja (ocena 2).*
Figure 3. *The surface of the canal wall of a sample irrigated with a laterally perforated needle (SEM x1000). A few small agglomerations of debris on the canal wall surface (score 2), with a small amount of the smear layer (score 2).*

Slika 4. *Površina zida kanala ispiranog lateralno perforiranom iglom (SEM x 1000). Zid kanala korena čist, bez debrisa (ocena 1), nema razmaznog sloja, dentinski tubuli otvoreni (ocena 1).*
Figure 4. *The surface of the canal wall of a sample irrigated with a laterally perforated needle (SEM x 1000). Clean root canal wall (score 1), no smear layer, dentinal tubules open (score 1).*

Diskusija

U ovom istraživanju , svi uzorci su instrumentirani i ispirani po istom protokolu, ali sa različitim vrstama igala, tako da su dobijeni rezultati bili u funkciji vrste igle korišćene za ispiranje kanala korena zuba.Dobijeni rezultati su ukazali na postojanje statistički značajne razlike u količini preostalog dentinskog debrisa i razmaznog sloja na zidovima kanala korena nakon primene različitih igala za irigaciju.Upotreba lateralno perforirane igle rezultirala je manjom količinom debrisa i razmaznog sloja na površini zidova kanala korena.

Dobijeni rezultiti su u skladu sa nalazima Goldman-a i sar. koji su i predložili lateralno perforiranu iglu za irigaciju kanala korena.(10) Ispitujući efikasnost dostave različitih iriganasa, autori su zaključili da je dostava irigansa lateralno perforiranom iglom efikasnija u odnosu na konvencionalnu iglu i da ne zavisi od vrste irigansa. Perforirana igla, zapravo razvija hidraulični pritisak u kanalu, koji usmeren lateralno forsira materijal sa zidova kanala korena. Na ovaj način irigans rastvara veće količine debrisa, a omogućena je i bezbedna dostava veće količine irigansa. Kako debris nije uočen ni u apeksnoj trećini , autori su zaključili da lateralno perforirana igla omogućava distribuciju irigansa čitavom dužinom korenskog kanala.(11)

Dubina dostave irigansa u kanalu korena direktno utiče na kvalitet postignutog čišćenja. Demonstrirano je da se kanali ,od mesta uvodjenja igle ispiraju samo put koronarno.(13) U skladu sa tim, u ovom istraživanju korišćene su igle kalibra 27. Naime, igle manjeg kalibra (25,27,28 i 30) je moguće uneti dublje u kanal korena što rezultira boljom dostavom irigansa i efikasnijim ispiranjem.(2,14) Medjutim, ova tehnika irigacije nosi opasnost od mogućeg zaglavljivanja igle u kanalu korena sa posledičnim forsiranjem dentinskih opiljaka, nekrotičnog tkiva i mikroorganizama preko apeksa zuba.(15)

Takodje,veliki pritisak na klip šprica tokom irigacije može rezultirati ubrizgavanjem rastvora u PA tkivo. Pažljivo unošenje igle i lagano oslobadjanje u slučaju eventualnog zaglavljivanja umanjuju mogućnost komplikacija što je naročito važno u situacijama bez apikalnog stopa ili gde se kanali korena otvaraju direktno u maksilarni sinus.(2)

U ovom istraživanju kanali su tokom instrumentacije ispirani 2,5% rastvorom NaOCl-a. U ovoj koncentraciji rastvor ispoljava zadovoljavajuće antimikrobno delovanje (16,17) i organolitičku aktivnost ,(18) dok mu je toksičnost dvostruko manja u odnosu na rastvor pune koncentracije.(19) Važno je naglasiti da upotreba slabije koncentrovanih rastvora zahteva primenu veće količine irigansa ,odnosno njegovu čestu izmenu u kanalu korena.Efikasnost iriganasa u kanalima se umanjuje u prisustvu organskog materijala, što je narocito izrazeno prilikom upotrebe rastvora nižih koncentracija.(20)

Discussion

In the present study, all samples were instrumented and irrigated according to the same protocol, but with different types of needles. Therefore, the obtained results were in the function of the needle type used to irrigate root canals. The results revealed statistically significant differences in the amount of the remaining debris and smear layer on the root canal walls after irrigation with different types of needles. The use of laterally perforated needles resulted in less debris and smear layer on the root canal walls.

The present results are in accordance with the results of Goldman et al. who suggested the use of laterally perforated needles for root canal irrigation.[10] Studying the efficiency of irrigant delivery, the authors concluded that laterally perforated needles facilitated more efficient irrigant delivery than conventional needles irrespective of the irrigant type. The perforated needle develops a laterally directed hydraulic pressure within the root canal which allows the removal of the material from the wall surfaces. In this way, the irrigant dissolves more debris and safe delivery of higher quantities of the irrigant is enabled. Since debris was not observed even in the apical one third, the authors concluded that the laterally perforated needle favours the distribution of irrigants along the entire root canal wall.[11]

The depth of the irrigant delivery in the root canal directly affects the quality of cleaning. It has been shown that, from the needle tip within the root canal, irrigation occurs only in the coronal direction.[13] Based on this finding, needles #27 were used in the present study. Smaller size needles can be inserted deeper into the canal [25,27,28,30] which results in better irrigant delivery and more efficient cleaning.[2,14] However, this irrigation technique may lead to needle clenching within the canal with consequential extrusion of dentinal debris, necrotic tissue and microorganisms into the periapex.[15] Furthermore, higher pressure on the syringe may result in irrigant extrusion into the periapical tissue. Careful placement of the needle within the root canal and light release in the event of accidental clenching reduce the risk of complications which is particularly important in the situations without an apical stop or when root canals open directly into the maxillary sinus.[2]

In the present study, the root canals were irrigated with 2.5% NaOCl during instrumentation. This concentration of the NaOCl solution shows a satisfactory antimicrobial[16,17] and organolithical activity[18] whilst its toxicity is reduced to one half of that of the full concentration.[19] It is important to point out that the use of lower concentrations requires a greater amount of the irrigant i.e. its more frequent refreshing in the root canal. Irrigant efficiency in root canals is reduced in the presence of organic material and this is particularly the case when lower concentrations of the irrigant are used.[20]

Za finalno ispiranje korišćen je 17% rastvor EDTA.U ovoj koncentraciji i na neutralnom pH, rastvor EDTA ispoljava efikasno demineralizaciono delovanje.(21) Na važnost finalnog ispiranja, velikom količinom irigansa, po završenoj preparaciji kanala korena ukazali su Yamada i sar. sredinom 80-tih god.prošlog veka. Poredeći efikasnost različitih endodontskih iriganasa, korišćenih u različitim količinama, nalaze da je ispiranje sa 10 ml 17% EDTA praćeno sa 10 ml 5% NaOCl-a najefikasnija kombinacija rastvora u uklanjanju organskog debrisa i razmaznog sloja sa zidova kanala korena.(4)

Medjutim, iako veoma efikasna u čišćenju kanala, ova kombinacija rastvora može dovesti i do neželjenih pojava, koje se manifestuju erozijom dentina korena.Baumgartner i Mader nalaze da naizmenična primena NaOCl-a i EDTA rezultira kompletnim uklanjanjem razmaznog sloja i pulpnih ostataka sa instrumentiranih površina kanala, kao i kompletnim uklanjanjem pulpnih ostataka i predentina sa neinstrumentiranih površina. Ali ovi autori uočavaju i da na neinstrumentiranim površinama dolazi do pojave erozija i proširivanja dentinskih tubula. Kombinacija ovih rastvora naime, dovodi do progresivnog rastvaranja dentina, što po ovim autorima može biti posledica naizmeničnog delovanja NaOCl-a koji rastvara organsku komponentu dentina i EDTA koji demineralizuje njegovu neorgansku komponentu.(5) Erozije dentina zida kanala korena, nakon primene EDTA i NaOCl-a u većoj količini, tokom finalnog ispiranja, evidentirane su i u novijoj literaturi.(7) Hülsmann i sar. zapažaju i da primena helatniih agenasa u dužem vremenskom periodu (3, 6, i 9 minuta) dovodi do vremenski zavisnog gubitka težine dentina i do redukcije njegove mikrotvrdoće.(22) Iz tih razloga, u ovom istraživanju, tokom finalnog ispiranja korišćen je samo 17% rastvor EDTA koji je aplikovan u kanale korena u trajanju od 1 minuta kako su preporučili Çalt i Serper 2002 god.(6). Uzorci su zatim još ispirani destilovanom vodom u cilju eliminacije rastvorenog neorganskog materijala i neutralizacije korišćenih iriganasa.

Rezultati ovog istraživanja ukazuju da je primenjenim irigacionim protokolom postignuto dobro čišćenje u uzorcima ispiranim lateralno perforiranom iglom.Upotreba organskog i neorganskog rastvarača ,kao i primena velike količine iriganasa uticala je na bolji kvalitet cišćenja dentinskih zidova kanala korena. Medjutim treba napomenuti da i u ovoj eksperimentalnoj grupi, debris i razmazni sloj nisu bili u potpunosti uklonjeni kod svih testiranih uzoraka.

Zaključak

Primena lateralno perforirane igle za irigaciju kanala korena zuba rezultirala je efikasnijim uklanjanjem debrisa i razmaznog sloja sa zidova kanala korena u poredjenju sa konvencionalnom iglom za irigaciju.Medjutim, lateralno perforirana igla ne uklanja u potpunosti debris i razmazni sloj sa instrumentiranih površina kanala korena.

Final irrigation was performed with 17% EDTA solution. EDTA of this concentration at neutral pH shows efficient demineralising activity.[21] Yamada et al suggested the importance of the final flush with a great quantity of the irrigant in mid1980-ties. Comparing the efficiency of different endodontic irrigants, used in different quantities, these authors found that irrigation with 10 ml of 17% EDTA followed by 10 ml of 5% NaOCl was the best combination to remove the organic debris and smear layer from the canal walls.[4]

Although very efficient in canal cleaning, this combination of solutions may have certain adverse effects which are manifested as the erosion of root dentine. Baumgartner % Mader found that the use of NaOCl and EDTA results in complete removal of the smear layer and pulp remnants from the instrumented canal wall surfaces as well as the complete removal of pulp remnants and pre-dentine from the non-instrumented surfaces. However, these authors reported the occurrence of dentine erosion and enlargement of dentinal tubules even on the non-instrumented surfaces. The aforementioned combination of irrigants leads to the progressive dissolution of dentine which could be due the subsequent activity of an organic, NaOCl, and an inorganic solvent, EDTA.[5] Dentine erosion of root canal walls after the use of excess amounts of EDTA and NaOCl during the final flush have been reported in more recent literature.[7] Hülsmann et al. found time dependent weight loss of dentine after the use of chelating agents for 3, 6 or 9 minutes and the subsequent reduction in its microhardness.[22] Based on these findings, only 17% EDTA was used in the present study and applied to root canals for 1 min, as recommended by Çalt & Serper (2002).[6] The samples were finally irrigated with distilled water in order to eliminate inorganic material and neutralise previously used irrigants.

The present results indicate that the applied irrigation protocol ensured efficient cleaning of the samples irrigated with laterally perforated needles. The use of the organic and inorganic irrigants in large quantities resulted in better cleaning of the canal walls. However, it should be noted that, even in this experimental group, the debris and smear layer were not removed completely in any sample.

Conclusion

The use of the laterally perforated needle for root canal irrigation resulted in more efficient removal of the debris and smear layer from the canal walls compared to the conventional irrigation needle. However, the use of the laterally perforated needle did not result in the complete removal of the debris and smear layer from the instrumented canal surfaces.

References / Literatura

1. *Ruddle CJ:* Cleaning and shaping root canal system.In: Cohen S, Burn EC editor. *Pathways of the pulp. St Louis.Mostby, 2002:231-91*
2. *Walton RE, Rivera E.* Cleaning and shaping:Walton RE, Torabinejad M. *Principles and practice of endodontics. 2th ed. Philadelphia: WB Saunders,1996:201-33*
3. *Živković S, Brkanić T, Dacić D, Opacić V, Pavlović V, Medojević M.* Razmazni sloj u endodonciji. *Stom Glas S 2005;52:7-19*
4. *Yamada RS, Armas A, Goldman M, Lin PS.* A scenning electron microscopic comparasion of a high volume final flush with several irrigating solutions:part 3. *J Endod 1983;8:137-42*
5. *Baumgartner JC, Mader CL.* A scenning electron microscopic evaluation of four root canal irrigation regimens. *J Endod 1987;13:147-57*
6. *Calt S, Serper A.* Time-dependent effects of EDTA on dentine structures. *J Endod 2002;28:17-9*
7. *Niu W, Yoshioka T, Kobayashi C, Suda H* .A scenning electron microscopic study of dentinal erosion by final irrigation with EDTA and NaOCl solutions. *Int Endod J 2002;35:934-9.*
8. *Guerisoli DMZ, Marschesan MA, Walmsley AD, Lumley PJ, Pecora JD.* Evaluation of smear layer removal by EDTAC and Sodium hypoclorite with ultrasonic agitation. *Int Endod J 2002;35:418-21*
9. *Takeda FH, Harashima T, Kimura Y, Matsumoto K.* A comparative study of the removal of smear layer by three endodontic irrigants and two types of laser. *Int Endod J;1999:32-9*
10. *Goldman LB, Goldman M, Kronman Jh, Lin PL.* Scanning electron microscopic study of a new irrigation method in endodontic treatment. *Oral Surg 1979;48:79-83*
11. *Goldman LB, Goldman M, Kronman JH, Pec SL.* The efficacy of several irrigating solutions for endodontics: A scanning electron microscopic study. *Oral Surg 1981;52;197-204*
12. *Gambarini G,Laszkiewicz J.* A scanning electron microscopic study of debris and smear layer remaining following use of GT rotary instruments. *Int Endod J 2002; 35:422-7*
13. *Chow W.* Mechanical effectiveness of root canal irrigation. *J Endod 1983;9:475-9*
14. *Weine FS.* Endodontic therapy.5th ed. *Mosby,1996*
15. *Becker Gl, Cohen S, Borer R.* The sequele of accidentally injecting sodium hypochlorite beyond the root apex. *Oral Surg 1974;38:633-8*
16. *Siqueira JF Jr, Rocas IN, Favieri A, Lima KC.* Chemomechanical reduction of the bacterial population in the root canal after instrumentation and irrigation with 1,5%, 2,5% and 5,25 % sodim hypochlorite. *J Endod 2000;26:331-4*
17. *Živković S, Pavlović V,Dačić D,Pavlica D.* Antimikrobni efekat sredstava za irigaciju kanala korena zuba. *Stom Glas S 2000;47:99-102*
18. *Beltz RE, Torabinejad M, Pouresmail M.* Qvantitative analysis of the solubilizing action of MTAD,sodium hypochlorite and EDTA on bovine pulp and dentin. *J Endod 2003;29:334-7*
19. *Zhang W, Torabinejad M, Li Y.*Evaluation of cytotoxity of MTAD using the MTT-tetrazolium method. *J Endod 2003;29:654-7*
20. *Hasselgren G, Olsson B, Cvek M.* Effect of calcium hydroxide and sodium hipohlorite on the dissolution of necrotic porcine muscle tissue. *J Endod 1988;125-7*
21. *Serper A, Çalt S.* The demineralizing effects of EDTA at different concentrations and Ph. *J Endod 2002;28:501-2*
22. *Hülsmann M, Heckendorff M, Schäfers F.* Comparative in vitro evaluation of three helator pastes. *Int Endod J 2002;35:668-79*

Adresa za korespondenciju
Asst. dr Violeta Pavlović
Klinika za Bolesti zuba i endodonciju
Rankeova 4, Beograd, Srbija
Tel. 064 112 56 88
e-mail: nadjapetrovic@yahoo.com

Adress for correspondence
Asst. dr Violeta Pavlović
Department of Restorative Dentistry
and Endodontics, School of Dentistry,
University of Belgrade
Tel. 00381 64 1125688
e-mail: nadjapetrovic@yahoo.com