



Choice of root canal irrigants by Serbian dental practitioners

Izbor rastvora za ispiranje kanala korena od strane stomatologa u Srbiji

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Abstract

Background/Aim. Root canal treatment is considered to be the one of the most important procedures in endodontic treatment. To irrigate the root canal it is most common to use sodium hypochlorite (NaOCl), chlorhexidine, ethylenediaminetetraacetic acid (EDTA), local anesthetic solution, while the most used in Serbia is hydrogen peroxide (H₂O₂). The aim of this survey was to reveal the preferred root canal irrigants used by general dental practitioners in Serbia and to determine the influence of the continuing education program, delivered over the 3-year observation period, on work habits of dental practitioners. This was the first comprehensive survey of this nature carried out in Serbia. **Methods.** The survey was conducted in two instances, a 4-month observation period each, from November 1, 2009 to March 1, 2010 and from November 1, 2012 to March 1, 2013. Internet Web Page Survey was posted on the official web site of the Serbian Association of Private Dentists. In the first survey, 569 completed questionnaires were subjected to analysis. In the next attempt (3 years later), the survey was launched again and 615 completed questionnaires were analyzed using the same criteria. The statistical analysis was carried out with simple descriptive statistics applying the χ^2 test, at a significance level of $p < 0.05$. **Results.** The first survey included 569 dental practitioners, while 3 years later the number of them was 615. Analyzing the questionnaires revealed the number of 10 to 30 interventions on the root canal monthly. The most commonly used irrigant solution was H₂O₂ in 2009, while in 2012 it was yet H₂O₂, but also NaOCl, chlorhexidine, and a little less EDTA. **Conclusion.** This study shows significant changes in the irrigation protocol applied in Serbian dental community. After 3 years of observation, NaOCl became widely accepted as the irrigant of choice, whereas H₂O₂ lost its popularity.

Key words:

tooth, root; irrigation; serbia; questionnaires; education, medical.

Apstrakt

Uvod/Cilj. Lečenje korenskog kanala smatra se jednim od najvažnijih koraka u endodontskom lečenju. Za ispiranje korenskog kanala najčešće se koriste natrijum-hipohlorit (NaOCl), hlor-heksidin, etilen-diaminotetrakisrtećna kiselina (EDTA), lokalni anestetik, a u Srbiji najčešće vodonik peroksid (H₂O₂). Cilj ovog istraživanja bio je da se odrede primarni irigacioni rastvori koje koriste opšti stomatolozi u Srbiji, kao i da se utvrdi mogući uticaj kontinuiranog obrazovanja na svakodnevne procedure endodontske terapije u toku 3-godišnjeg opservacionog perioda. Ovo je prva anketa ove vrste i ovog obima izvedena na teritoriji Srbije. **Metode.** Istraživanje je sprovedeno prikupljanjem podataka u dva četveromesečna perioda, od 1. novembra 2009. godine do 1. marta 2010. godine i od 1. novembra 2012. do 1. marta 2013. godine. Anketni obrazac bio je postavljen na zvanični WEB portal Srpskog udruženja privatnih stomatologa, i sadržao je 90 pitanja vezanih za godine bavljenja praksom, tehnike i instrumente vezane za proceduru, kao i za vrstu korišćenih irigacionih rastvora. U okviru prve ankete analizirano je 569 popunjenih upitnika. Tri godine kasnije, u ponovljenom istraživanju, istim setom kriterijuma analizirano je 615 popunjenih obrazaca. Statistička analiza sprovedena je jednostavnom deskriptivnom statistikom, χ^2 -testom, sa nivoom značajnosti od $p < 0.05$. **Rezultati.** U prvoj anketi učestvovalo je 569 stomatologa, a nakon tri godine 615. Analiza upitnika pokazala je da je broj intervencija na korenskom kanalu iznosio od 10 do 30 mesečno. Najčešće korišćen rastvor za irigaciju bio je H₂O₂ u 2009. godini, a 2012. godine on se još uvek često koristio kao rastvor za ispiranje, ali, takođe, korišćeni su u većem obimu i NaOCl, hlorheksidin, a nešto manje i EDTA. **Zaključak.** Studija je ukazala na značajne promene u primeni irigacionog protokola među srpskim stomatolozima. Po isteku 3-godišnjeg opservacionog perioda, NaOCl je postao široko rasprostranjeno, preferentno irigaciono sredstvo, dok je H₂O₂ izgubio na popularnosti.

Ključne reči:

zub, korenski kanal; lavaža; srbija; upitnici; edukacija, medicinska.

Introduction

Root canal treatment (RCT) is considered to be the essential element of dental services delivered to the population in developed countries. Various investigations were carried out to explore the standards and trends of endodontic treatment performed by general dental practitioners worldwide¹⁻⁹. However, the data on the attitude of general dental practitioners toward various aspects of endodontic treatment in developing countries are still scarce and/or inadequate.

Irrigation of root canal system is recognized as one of the most important steps, and the most critical one during endodontic treatment. Despite modern technologies and equipment, more than one third of the root canal surface can be left uninstrumented¹⁰. The residuals of necrotic or vital tissue within the root canal space are the main etiological causes of endodontic failures, and therefore the irrigation protocol plays a key role in disinfection of the root canal space. As there is still no ideal root canal irrigant described by Zehnder¹¹, many kinds of endodontic irrigants have been investigated and none of them has been able to exhibit all the desired properties.

Sodium hypochlorite (NaOCl) seems to be the most popular irrigant, since it has a broad antibacterial spectrum, while also possessing some ability to inactivate endotoxins^{1-6,12}. Therefore, NaOCl remains the irrigant of choice worldwide in spite of its high toxicity, inability to completely remove the smear layer, and very unpleasant taste to patients. However, antibacterial trait of 2% chlorhexidine¹³ has made it one of commonly used endodontic irrigants. Ethylenediaminetetraacetic acid (EDTA), a chelating agent that helps in removing the inorganic component of the smear layer¹⁴, is also known as one of frequently applied root canal irrigants¹⁰. Local anesthetic solution has been reported as routinely used endodontic irrigant amongst some dentists in UK¹⁵, while hydrogen peroxide of 3% was popular and widely used amongst Serbian dentists in Serbia previously^{16,17}.

In spite of the progress that academic teaching and endodontic societies have made so far in this field of growing interest, there is a lack of relevant information regarding the attitude of general dental practitioners towards irrigation protocol. What still remains unknown is how far the changes in endodontics have been incorporated into daily practice of private surgeries and public hospitals in Serbia. So far, there have been neither surveys nor researches concerning endodontics standards and general attitude toward root canal treatment in Serbian dental community.

The aim of this survey was to reveal the preferred root canal irrigants used by general dental practitioners in Serbia and to determine the influence of continuing educational program, delivered over the 3-year observation period, on work habits of dental practitioners. This was the first comprehensive survey of this nature carried out in Serbia.

Methods

This longitudinal survey was designed to cover some important aspects of endodontics. The appropriate questionnaire was designed of 90 questions that comprised the following items: main professional activity, years of professional activity,

willingness to perform endodontics, reasons not to perform root canal treatment, details on working environment and equipment, use of rubber dam, applied root-canal preparation techniques, choice of instruments, sterilization procedures, choice of root-canal irrigant, utilization and choice of intracanal medication, etc.

For the purpose of this particular part of investigation, only questions related to selection of root canal irrigants were extracted and analyzed.

Internet Web Page Survey was posted on the official web site of the Serbian Association of Private Dentists, easily accessible to all its members (<http://www.privstom.org.rs>). An introductory cover letter that clearly stated the purpose of the survey was followed by the questionnaire designed to provide reliable answers to the research questions raised. Data were collected during the four-month observation period starting from November 1, 2009 to March 1, 2010 and then from the November 1, 2012 to March 1, 2013. In order to make a more detailed comparison of the data, the sample obtained from both surveys was divided into groups defined by the years of professional experience as follows: group 1 (less than a year of professional experience); group 2 (2–5 years); group 3 (5–10 years); group 4 (10–15 years), group 5 (15–20 years), and group 6 (more than 20 years of clinical practice).

The data were presented by tables and figures. Mean values of endodontic treatments obtained in the two observation periods were calculated using the Students *t*-test. Comparison of RCTs in relation to the type of irrigants was performed with ANOVA test. A difference between the groups was determined by *post hoc* analysis. Comparison of frequency was performed with nonparametric χ^2 -test. A correlation between the number of RCTs and years of professional experience was performed by Pearson and Spearman correlation. Statistical analysis was performed with the SPSS (version 18) at a significance level $p < 0.05$.

Results

In the first survey, 569 completed questionnaires were obtained and subjected to analysis. In the next attempt (three years later), the survey was launched again and 615 obtained questionnaires were analyzed using the same criteria. There were 369 repeated respondents who were surveyed in both observation attempts.

Responses were obtained from the different groups of participants clustered by the years of professional experience. It is obvious that the respondents were not evenly distributed in terms of the elapsed professional experience. By observing the obtained statistical sample of 1,184 respondents in total (569 in 2009 and 615 in 2012), it can be noticed that the majority of the respondents had professional experience from 6–10 years: 45.3% in 2009 and 36.7% in 2012 (Figure 1).

There was a wide variation in the number of root canal treatments (RCTs) performed *per* month ranging from less than 10 to over 30. The average number of RCTs in 2009 was 15.36 ± 5.94 , and it was statistically nonsignificant when compared to the average number of RCTs in 2012: 15.12 ± 7.03 ($t = 0.586$; $p = 0.558$). However, there was a significant

correlation between the number of RCTs and years of professional experience in 2009 ($r = 0.523$; $p < 0.001$), and that correlation was almost the same in 2012 ($r = 0.302$; $p < 0.001$). Almost all experienced dentists stated that they have completed between 10 and 30 root canal treatments each month in 2009, as well as in 2012 (Table 1).

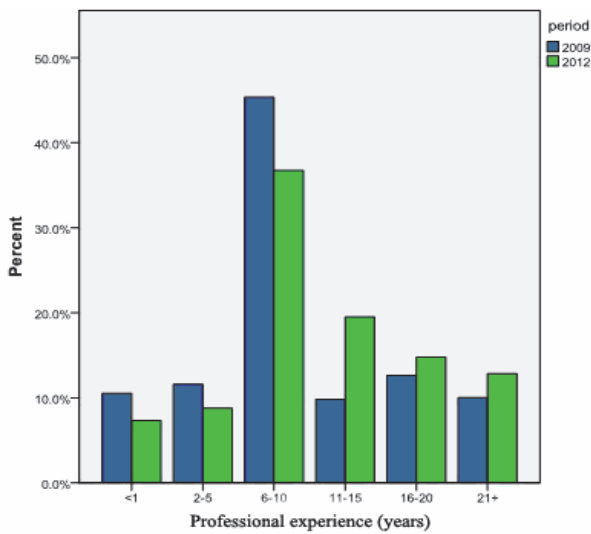


Fig 1 – Distribution of the respondents according to years of professional experience.

The most popular irrigant in the first survey was hydrogen peroxide, and it was used by all respondents regardless of their years of professional experience. Its use was significantly greater than that of any other solution ($p < 0.001$). It was highly significant that in the 3 groups (with professional experience from 6 to 20 years) hydrogen peroxide was the only irrigant for root canal treatment. The most experienced practitioners (group 6), and very young dentists (group 1) used broader variety of solutions in the irrigation protocol than the other groups. The respondents with professional experience of less than one year also used chlorhexidine and EDTA.

NaOCl was used as root canal irrigants only among dentists with 2–5 years of professional experience (25.8%) (Figure 2).

None of the respondents declared the use of either MTAD (a mixture of doxycycline, citric acid and a detergent) or artificial saliva as a root canal irrigant.

However, in the second survey, the ratio between the use of hydrogen peroxide and sodium hypochlorite significantly changed since NaOCl became the most popular irrigant in all the groups ($p < 0.001$). Hydrogen peroxide was still popular among all the respondents, but significantly less than in the previous survey ($p < 0.001$) (Figure 2). The second survey also revealed the increased use of chlorhexidine, especially in the first group comprising young dentists. More than 10% of dentists in the third group started to use chlorhexidine during the

Table 1
Frequency and the number of root canal treatments (RCT) according to years of professional experience

Years of professional activity	RCT/month						Total	<i>p</i>
	<1	2–5	6–10	11–15	16–20	21+		
2009, n (%)								
< 10	60 (100.0)	48 (72.7)	36 (14.0)	32 (57.1)	0 (0.0)	0 (0.0)	176 (30.9)	
10–30	0 (0.0)	18 (27.3)	222 (86.0)	24 (42.9)	72 (100.0)	57 (100.0)	393 (69.1)	< 0.001
2012, n (%)								
< 10	45 (100.0)	36 (66.7)	30 (13.3)	67 (55.8)	22 (24.2)	0 (0.0)	200 (32.5)	
10–30	0 (0.0)	18 (33.3)	196 (86.7)	53 (44.2)	69 (75.8)	79 (100.0)	415 (67.5)	< 0.001

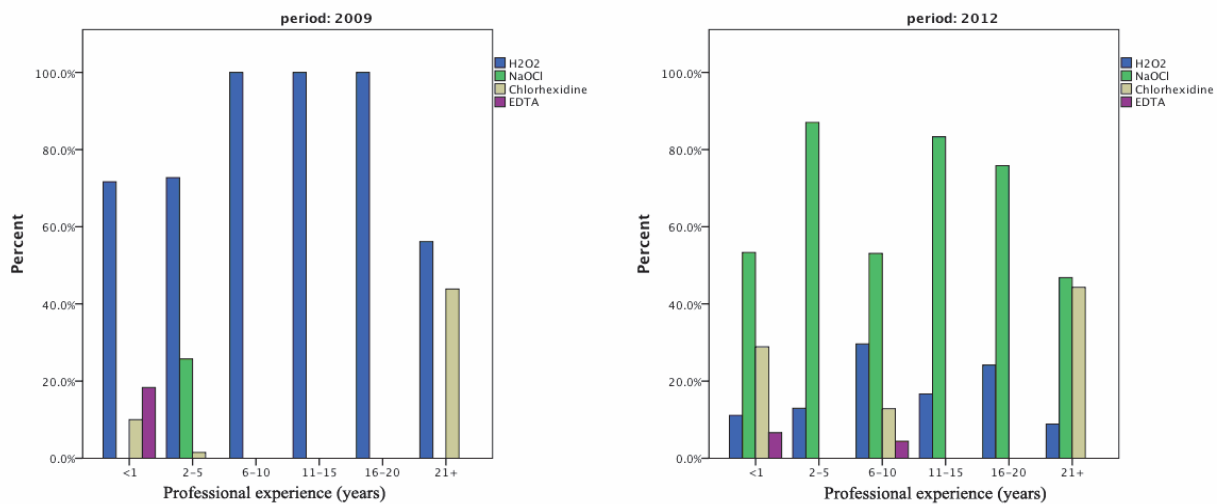


Fig. 2 – Preferred root canal irrigants per respondent groups.

observatio period. EDTA did gain minor popularity, but far behind NaOCl.

In the 2009 research, the majority of dentists who used sodium hypochlorite (57%) chose the full-strength concentration (> 5.0%). Three years later, only 6.2% of all the respondents used full-strength NaOCl concentrations, which is an obvious statistically significant difference. ($\chi^2 = 107.9$; $p < 0.001$). In the second survey, the use of concentration of 2.5% was significantly greater than in the previous survey (59% vs 18.3%, respectively; $\chi^2 = 35.30$; $p < 0.001$) (Table 2).

Table 2
Preferred concentration (%) of sodium hypochlorite (NaOCl)

Concentration of NaOCl (%)	Dentists(%)	
	2009	2012
1.5	30.00	34.80
2.5	18.33	59.03
5.0	51.67	6.17

None of the dentists reported using rubber dam routinely. There were 7 (1.23%) respondents who stated that they occasionally used rubber dam for endodontic treatment in 2009. In the repeated survey this number was almost the same, 8 respondents (1.3%). There was no correlation between its use and years of professional experience, and it was an insignificant factor to be correlated with the choice of root canal irrigants.

Discussion

This survey encompassed 569 licensed general dental practitioners in 2009, and 615 general dental practitioners in 2013 and thus provided a large basis for the research (it should be noted that there were less than 6,000 licensed dental practitioners in Serbia during the entire observation period). Thus, the number of respondents in both surveys was at least double compared to other dental communities where similar surveys were previously employed: 602 questionnaires were analyzed in an endo survey in Turkey¹, 131 replies were collected from an endodontic survey in North Jordan⁵, 343 valid responses were processed from questionnaires of endo survey from Hong Kong³, whereas less than 300 answers were obtained from a Flemish survey⁶, and 205 dentists were surveyed in a pilot study from Saudi Arabia¹⁸.

The respondents with professional experience ranging from 6 to 15 years (groups 3 and 4) comprised more than half of total respondents in both the first and the second survey, similarly to the findings of a Turkish endodontic survey from 2012¹. The most of the responses came from the group with professional experience from 10 to 15 years. The same trend was noticeable in some other previously mentioned investigations^{1,3}. In the second survey, the number of respondents in this specific group doubled. The prospective reason could be a natural migration of practitioners from the group 3 (as defined in the survey of 2009) to the next one. The number of responses among predefined groups (according to the years of professional experience) was not evenly distributed, and the number of responses in each

of the groups might not reflect the present state in the Serbian dental community. It rather highlights the fraction of dental practitioners that regularly take part in continuing education programs, and those with more than average exposure to the modern IT technologies.

The average number of RCTs in both periods was almost the same, and it was quite similar to findings from research conducted in Turkey¹ (15 vs 12.8 RCTs per month). However, there was a significant correlation between the number of RCTs and years of professional experience in both periods, which is in contrast to findings from the survey mentioned above, where no correlation was found between the number of RCTs and the age of the practitioners. In our study, the practitioners working more than 16 years performed significantly more RCTs than others. It appears that experienced practitioners could be better supplied with modern endodontic instruments and technology (e.g. rotary endo). Moreover, their experience-based self-confidence could play a considerable role in this matter. In the same manner, experienced practitioners could accomplish more specific trainings on endodontics techniques.

The most popular irrigating solution in the first survey from 2009 was H₂O₂. At that time, the usage of hydrogen peroxide was significantly greater than the usage of any other solution ($p < 0.05$). It was revealed that 89.46% of the respondents used hydrogen peroxide, whereas only 8.9% of them chose NaOCl. In the past, hydrogen peroxide was popular amongst European dentists¹⁹, but in recent years it has been seldom applied. It has been reported to be in frequent use only in a survey from North Jordan⁵. In the first observation period we found significant differences in the choice of irrigating solutions employed among the observed groups, which is in contrast to findings from endodontic survey in North Jordan⁵, where professional experience was not reported to influence the irrigation habits. There is a considerably large group of Serbian dentists who exclusively used hydrogen peroxide for root canal irrigation. High popularity of H₂O₂ in Serbian dental community cannot be explained by low price, as NaOCl is considerably cheaper. However, it has been the choice of preference amongst general dental practitioners in Serbia for many years now. There is no rational explanation for this finding, and one of the reasons could be the habits from the past and educational inconsistencies of undergraduate curricula in temporal domain.

Three years later, the repeated survey showed an extremely changed choice of irrigants used, and NaOCl became the dominant irrigation solution. These new findings are consistent with findings from similar studies: approximately 70% of dentists used NaOCl in a survey from Saudi Arabia, over 60% of surveyed dentists in Hong Kong used NaOCl, a survey conducted in Australia reported that 94% of endodontists used sodium hypochlorite, and a survey performed in North Jordan reported that 32.9% of general dentist used sodium hypochlorite. In some other studies the selection of irrigant could be associated with the use of rubber dam, as it was found that 70% of rubber dam users among British dentists irrigated with sodium hypochlorite, whilst non-users tended to use local anesthetic solution¹⁵. Regarding our study, after the

second observation period, we found that the vast majority of our respondents were non-users of rubber dam but all of them used sodium hypochlorite. A similar attitude toward using sodium hypochlorite without using rubber dam for isolation was also reported amongst Flemish dentists⁶. The reasons for such ignoring rubber dam in the Serbian dental community could be addressed primary to insufficient education in the undergraduate teaching curriculum, inadequate skills, and lack of training, following by high cost, extra time, and prospective patient's consent. The use of sodium hypochlorite, especially in full strength concentration, without rubber dam isolation, presents a potentially dangerous practice in the use of such irritant irrigation solutions.

In the second observation period, chlorhexidine also gained popularity, but ranked far behind NaOCl. Chlorhexidine was used by very young and very experienced dentists. A greater popularity of chlorhexidine could be explained by its significantly lower toxicity compared to NaOCl, and significantly prolonged shelf life. EDTA is clearly the least applied irrigant in both surveys. That might be due to its relatively high cost and lack of availability on the local market. However, actual reasons for that are yet to be investigated.

The study also revealed a change in the preferred concentration of NaOCl that was applied by the vast majority of dental practitioners in the repeated survey. After the 3-year observation period, the most frequent percentage of NaOCl appeared to be 2.5%, and that might be influenced by continuing educational programs during the 3-year observation period, since that concentration is in accordance with noticed trends worldwide.

This drastic change in preferred irrigant after only 3 years that elapsed between the two studies could be a consequence of delivered programs of continuing education that influenced attendants and brought them closer to contemporary endodontic trends. During the observation period, 237 workshops accredited by the Health Council of Serbia were designed and delivered by the members of teaching staff from dental schools in Serbia. Many of these sessions were repeated a couple of times at different Serbian

towns, in attempt to cover all the regions of the country. All meetings were timely announced at Serbian Association of Private Dentists web site (<http://www.privstom.org.rs>)²⁰, as well as in electronic and printed media.

Old habits die hard, but persistence in dissemination of progressive approaches obviously yields results and eventually gains success if the curriculum is presented in a proper manner and supported with appropriate evidences. It seems that continuing education programs provide solid basis for experience exchange and motivate open-minded dental practitioners to step outside previously acquired dogmatic standpoints.

The purpose of this survey was to reveal the preferred root canal irrigants used by general dental practitioners in Serbia and to determine the prospective influence of continuing educational program delivered over the 3-year observation period. This was the first comprehensive survey of this nature carried out in Serbia, and with this report we wanted to present the baseline data for further investigation, and determine the trends and changes which could influence continuing education topics and general strategy.

However, there were some limitations to our study: despite popularity of web surveys, and their numerous advantages (rapid response, low cost and flexibility), these also carry significant sampling limitations: only a fraction of Serbian dentists willing to take part in a survey actively use IT technologies and there is always a possibility that repeated participation in the survey by the same individual might distort the results.

The preliminary findings from this study indicate that continuing educational programs might be a valuable vehicle for dissemination of alternative approaches amongst dental professionals in Serbia.

Conclusion

This study points to significant changes in the irrigation protocol applied in Serbian dental community. After 3 years of observation, NaOCl has become widely accepted as the irrigant of choice, chlorhexidine also gained popularity, whereas H₂O₂ lost its undue popularity from the past.

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