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EVALUATION OF ACTIVITIES AIMED AT PREVENTING MICROBIOLOGICAL RISKS IN DENTAL PRACTICE

OCENA DZIAŁAŃ UKIERUNKOWANYCH NA ZAPOBIEGANIE ZAGROŻENIOM MIKROBIOLOGICZNYM
W PRACY STOMATOLOGA

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ABSTRACT

Background: Microbiological contamination of water in dental unit waterlines (DUWL) creates a risk of cross-infections, and is a source of biological risk factors in the work environment of a dentist. The aim of the study was to evaluate dentists' knowledge on DUWL microbiological contamination and the scope of activities/procedures they undertake to monitor it. **Materials and Method:** The questionnaire survey was conducted in 2010 among 107 Polish dentists using dental units in everyday clinical practice. **Results:** It has been found that in their daily practice, dentists do not follow procedures leading to reduction or elimination of microbiological contamination of dental unit reservoir water. They are not aware of microbiological contamination of DUWL that supply working handpieces with water. They are unaware of the principles of dealing with dental water and water supply systems or the health risk posed by microbiological contamination of unit water for a dental team and patients. **Conclusions:** It is necessary to provide dentists with information on microbiological contamination of water in dental units, on the correct procedures of handling water and waterlines that supply working handpieces with water. *Med Pr* 2013;64(1):11–17

Key words: dental equipment, water microbiology, infection control

STRESZCZENIE

Wstęp: Mikrobiologiczne skażenie wody w instalacji wodnej unitów dentystycznych stwarza zagrożenie zakażeniami krzyżowymi, stanowiąc źródło szkodliwych czynników biologicznych w środowisku pracy stomatologa. Celem badań była ocena wiedzy dentyistów na temat skażenia mikrobiologicznego wody z unitów dentystycznych oraz zakresu czynności/procedur, które powinny być podejmowane w celu monitorowania tego skażenia. **Materiały i metoda:** Badanie ankietowe przeprowadzono w 2010 r. wśród 107 polskich stomatologów używających unitów dentystycznych w praktyce klinicznej. **Wyniki:** W codziennej pracy dentyści nie stosują procedur minimalizujących/eliminujących mikrobiologiczne skażenie wody w zbiornikach unitów dentystycznych. Nie mają oni wiedzy na temat skażenia instalacji wodnej dostarczającej wodę do końcówek roboczych, nie znają zasad postępowania z wodą z unitów ani z instalacją wodną, nie są też świadomi zagrożeń zdrowotnych stwarzanych przez mikrobiologiczne skażenie wody w unitach dla zespołu stomatologicznego i pacjentów. **Wnioski:** Konieczne jest dostarczenie dentyistom informacji na temat problemu mikrobiologicznego skażenia wody w unitach dentystycznych oraz procedur prawidłowego postępowania z wodą w instalacjach wodnych unitów. *Med. Pr.* 2013;64(1):11–17

Słowa kluczowe: sprzęt stomatologiczny, mikrobiologia wody, kontrola infekcji

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INTRODUCTION

The propensity of micro-organisms, and especially bacteria, which colonize the surfaces of dental unit waterlines (DUWL) and form biofilm is a widespread phe-

nomenon (1–3). The biofilm environment in DUWL creates conditions conducive to multiplication of viruses, bacteria, fungi, protozoa and amoebae (4–8), which are the source of microbiological contamina-

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tion of water in DUWL. While working, dental unit handpieces (high-speed and low speed handpieces, air-water syringe, scaler) emit microbiologically contaminated aerosol and splatter containing water flowing from DUWL (9–11). Microbiological contamination of water in dental units used in treatment creates a risk of cross-infections in daily dental practice, especially as eradication of biofilm and prevention against recolonization is extremely difficult (1,8,12,13).

The presented research aims at evaluation of the knowledge and the scope of preventive measures used in daily dental practice to minimize or eliminate the exposure to microbiological risk factors present in dental unit water.

MATERIALS AND METHOD

The studied population comprised 107 dentists working at general dental surgeries and using dental units in their daily clinical practice. The dentists voluntarily answered 15 questions included in an anonymous questionnaire. The survey questionnaire is an adaptation of Kamma et al. (14), and it was extended with questions about handling the tubing system that drains liquids off dental units. The survey was conducted in 2010 during one of the training meetings of the Polish Dental Association. The values of the analyzed answers are presented using size and percentage.

RESULTS

Analysis of the answers shows that dental units used as basic equipment in dental surgeries were most frequently 5–10 years old (61.68%), and in 90.65% of all the studied units, the source of water was an inbuilt reservoir. The units are presented in Table 1.

In daily clinical practice, a reservoir/bottle in units with closed water system is replenished after disinfection of the reservoir/bottle (52 respondents – 48.60% of the tested group). Because the units are connected to a municipal water system, 10 people (9.35% of the group), did not choose any of the possible answers about the way they fill up reservoirs/bottles, and in 4 cases the question was not answered (3.73% of the group). No surgery with a closed water system unit used chemical products to disinfect water in the reservoir/bottle. Disinfection of the pipes delivering water to unit handpieces was performed every day by 42.06% of the tested group (45 respondents), while 57.94% of the group (62 respondents) failed to do it. The percentage of the

Table 1. Characteristics of dental units used in surgeries of surveyed Polish dentists

Tabela 1. Charakterystyka unitów dentystycznych używanych w gabinetach ankietowanych polskich stomatologów

Parameter Parametr	Dental units Unity dentystyczne (N = 107)	
	n	%
Age [years] / Wiek [w latach]		
< 1	3	2.80
1–5	17	15.88
5–10	66	61.68
> 10	18	16.82
no answer / brak odpowiedzi	3	2.80
Water source / Źródło wody		
reservoir/bottle / zbiornik/butelka	97	90.65
municipal water system / miejski wodociąg	10	9.35

respondents who rinsed the waterlines on a daily basis (by letting water from the working handpieces) after each patient – 48.60% of the tested group (52 respondents) – was close to the percentage of dentists who did not do it – 51.40% of the group (55 respondents). It is symptomatic that none of the respondents tested the microbial composition of water in the tubing delivering water to the handpieces of the unit used in their surgery (Table 2).

Disinfection of the tubing system that drains liquids off the unit (saliva ejector, suckers) is much more frequently practiced by dentists – 90.65% of the tested group (97 respondents) used this method in daily practice, while 9.35% of the group (10 respondents) failed to do it. However, only slightly over half of the dentists – 52.34% of the group (56 respondents) – did it every day, while 35.51% of the group (38 respondents) – did it once a week, 2.80% of the group (3 respondents) – once a month, and none – less frequently. Ten respondents (9.35% of the tested group) did not answer this question (Table 2).

Sufficient knowledge on the subject is the basis for the use of correct procedures to prevent microbiological contamination in a dental surgery, including the contamination resulting from the use of dental units. Forty-eight respondents (44.86%) of the tested group believed that the microbiological quality of water delivered to the unit was the same as the quality of water flowing

Table 2. Preventive measures reducing/eliminating microbiological contamination of dental unit waterlines and system draining liquids off the unit in surgeries of surveyed Polish dentists**Tabela 2.** Działania zapobiegawcze redukujące/eliminujące skażenie mikrobiologiczne przewodów wodnych i systemu odprowadzającego płyny z unitu dentystycznego w gabinetach ankietowanych polskich stomatologów

Preventive measures Działania zapobiegawcze	Dental units Unity dentystyczne (N = 107)	
	n	%
Replenishment of water reservoir/bottle / Uzupełnianie wody w pojemniku/butelce		
water is poured after reservoir/bottle disinfection / woda dolewana po dezynfekcji pojemnika/butelki	52	48.60
water is poured without reservoir/bottle disinfection / woda dolewana bez uprzedniej dezynfekcji pojemnika/butelki	41	38.32
municipal water system / miejski wodociąg	10	9.35
no answer / brak odpowiedzi	4	3.74
Disinfection of water in reservoir/bottle / Dezynfekcja wody w pojemniku/butelce		
chemical disinfection / chemiczna dezynfekcja	–	–
no disinfection / brak dezynfekcji	97	90.65
no answer / brak odpowiedzi	10	9.35
Waterlines rinsing between patients to prevent cross-infection / Przepłukiwanie przewodów wodnych przed kolejnymi pacjentami w celu zapobieżenia zakażeniu krzyżowemu		
running water through dental unit working handpieces / wypuszczanie wody przez końcówki robocze unitu dentystycznego	52	48.60
no rinsing / brak przepłukiwania	55	51.40
Liquid draining system / System odprowadzania płynów		
disinfection of the tubing system draining liquids off unit / dezynfekcja przewodów systemu odprowadzającego płyny unitu		
yes / tak	97	90.65
no / nie	10	9.35
Disinfection frequency / Częstotliwość dezynfekcji		
every day / codziennie	56	52.34
once a week / raz w tygodniu	38	35.51
once a month / raz w miesiącu	3	2.80
less frequently / rzadziej	–	–
no answer / brak odpowiedzi	10	9.35

from the working handpieces, while 52 respondents (48.60%) had a different opinion, and 4 respondents (3.74%) answered: “I don’t know”. This corresponded to the belief held by 42.06% of the tested group (45 respondents) about the actual risk, created by effluent water, to patients and dentists, while 55.14% of the group (59 respondents) believed that there was no such risk. Interestingly, 33.64% of the tested group (36 respondents) indicated their lack of knowledge on the subject as the cause of failing to disinfect water in the reservoir,

and 16.82% of the group (18 respondents) pointed to the fact that it was not obligatory. None of the respondents chose answers: “It is not important”, “It takes too much time”, or “It is too expensive”. Fifty three respondents (49.53%) left this question unanswered.

Slightly over 1/5 of the respondents (22.43% of the tested group) evaluated their knowledge concerning methods of handling water and waterlines providing the handpieces with water as sufficient to follow the correct procedures, while almost 3/4 of the respondents

(74.77% of the group) believed their knowledge was insufficient. Three respondents gave no answer. Consequently, the need for information/advice on the subject was felt by 90.65% of the tested group (97 respondents), while the remaining dentists did not feel such a need (9.35% of the group – 10 respondents).

The main cause of failing to handle the tubing draining liquids off the unit properly was the lack of knowledge on the subject: such an answer was given by 14.02% of the tested group (15 respondents), while 9.35% of the group (10 respondents) chose answer: “It is not obligatory”. No respondent indicated answers: “It is not important”, “It takes too much time”, or “It is too expensive”. The remaining dentists who disinfect the unit draining system failed to answer the question concerning causes of not following this procedure (76.63% of the tested group, 82 respondents).

DISCUSSION

In a dental office, patients are treated with increasingly complex technical devices, including dental units the water systems of which are extensively contaminated with microorganisms (15). High contamination levels were found in water samples taken from both new and old units (16). Studies on the microbiology of DUWL and biofilms in general dental practices across seven European countries confirm that a considerable proportion of DUWL show high levels of microbial contamination, irrespective of the country, type of equipment, and water source (17). Among DUWL-colonizing microorganisms there are opportunistic pathogens, e.g. *Legionella pneumophila pneumoniae* (17–19). Research results confirm that dental unit waterlines as well as unit working handpieces may also be contaminated with viral agents, among others HBV, HCV and HIV, and constitute a source and vehicle of cross-infection (20). Therefore, it is necessary to follow the principles of the correct use of a dental unit, including procedures and methods to reduce or eliminate the exposure to microbiological factors present in DUWL (16,18,21–24), especially as they constitute biological hazards in dentists' work environment.

This is undoubtedly related to the awareness and knowledge dentists should have on the issue. Our study showed that the majority of the surveyed Polish dentists (80%) used more than 5-year old dental units, while only 2.80% of the units were new (i.e. used for less than a year). Similar studies conducted in West-European countries show that 60% of dental offices are equipped

with units over 5 years old, while in about 8% of dental offices units are less than one year old (14). Our study shows that with regard to the possibility of maintaining good microbiological quality of water in DUWL, the situation in Poland is less favourable than that in other European Union countries. It was found that waterlines rinsing, confirmed to reduce bacterial counts in dental unit water, is more effective in new units than in old ones (16).

It is believed that a closed water system in a dental unit makes it easier to maintain an appropriate microbiological quality of water than an open system. Chemical disinfectants are applied at the water intake – the source of water, in this case a container or a bottle. This guarantees the correct concentration of disinfectant, enables monitoring of the microbiological quality of water in DUWL, and has proved safe and efficacious (25). In this respect, the situation in Polish dental offices is very good – 90.65% of the units are equipped with a water reservoir, usually a plastic bottle, so it is possible to apply one of chemical disinfectants (26). European research shows that in the Netherlands, Greece and Germany over 98% of dental units are provided with water by municipal water systems, which obstructs the use of chemical disinfectants. In Spain and Ireland, 18% and 77%, respectively, of dental units were equipped with water reservoirs. Among the studied dental units in Western Europe, only 9% were supplied with water from plastic bottles (14).

Our research shows that the tubing supplying working handpieces with water is disinfected by 42.6% of the respondents, while it is not disinfected by 57.94%. Because none of the surveyed dentists uses chemical products to disinfect water, it means that in practice they disinfect the so-called hoses. The surface of hoses covering, among others, DUWL tubing delivering water to working handpieces is decontaminated with disinfecting liquids or sprays.

The lack of knowledge on DUWL water disinfection was admitted by 33.64% of respondents, while 16.82% of them claimed that it was not obligatory. It is significant however, that almost half of the respondents did not select any answer to this question. This may confirm their lack of knowledge and explain why they do not disinfect water in the unit reservoir.

Research results published in 2004 show that 52% of 931 American dentists did not disinfect DUWL, and the most common cause was the conviction that it was not important (38%) and not obligatory (32%). The problem of high costs of disinfection was indicated

by 6% of the respondents, while 14% of the dentists responded that disinfection was time-consuming (27).

More recent European research shows that 55% of general dentists do not wash nor disinfect DUWL, while in the Netherlands it is true about 78%, in Ireland – 68%, in Greece – 91%, and in Germany – 21% of the surveyed dentists (14).

Dental unit water may be disinfected with various products: Oxygenal, Dentosept, BioBlue, Orotol, Alpron and sodium hypochlorite (14). In the United States, DUWL were chemically rinsed with products based on: alcohol – 4%, chlorhexidine – 26%, chlorine – 26%, silver – 3%, and also containing iodine – 6%, hydrogen peroxide – 4%, other substances – 31% (27). Our earlier studies demonstrated antibacterial and antifungal effectiveness of Oxygenal 6 (KaVo) (28,29).

DUWL rinsing by letting water flow from working handpieces between treatment of subsequent patients is believed to be an effective method to reduce microbiological contamination of water flowing from handpieces and to eliminate microorganisms that might penetrate DUWL as a result of a suck-back of fluids from a previously treated patient. Similar proportions of Polish dentists (48.60%) and those from other European countries (49%) rinse DUWL between subsequent patients (14).

Only 42.06% of Polish dentists are convinced about the health risk created by water flowing from unit working handpieces for patients and dentists, while 55.14% are not aware of this hazard. In other European Union countries, 50% of the respondents-dentists were aware that water flowing from DUWL may create a threat to health, while 35% believed that the threat concerns mainly themselves, 32% – other members of dental team, and 48% – the patients (14).

None of the dentists surveyed tested the microbiological composition of water delivered to unit working handpieces. The surveys of dentists from other European countries showed slightly better results. Although 83% of respondents never examined water in their unit, 89% were in favour of conducting regular tests of the microbiological quality of water (14). Among the American dentists surveyed, 79% responded that they do not test water to assess its microbiological contamination, but 4% do such a test every week, 5% – every month, 5% – every three months, and 6% – once a year (27).

Our study shows that the level of contamination may be related to the kind of procedures performed in dental offices: the lowest level is found in conservative den-

tistry, followed by periodontology and prosthodontics. It also depends on the degree of using the handpieces, as well as water softening and heating. The latter are particularly important as factors conducive to *Legionella pneumophila* proliferation (19).

Evaluation of the surveyed dentists' awareness of the problems of microbiological contamination of dental unit water shows that their knowledge should be supplemented by self-education and post-diploma training, as well as courses offered to dentists by dental unit manufacturers. Among Polish dentists, 80% believe that their knowledge about handling water and DUWL is insufficient and 97% expect information in this area. In the group of dentists from other European Union countries, 66% did not have such knowledge (14).

The importance of education for reducing risk exposure in a dental office is confirmed by the way dentists deal with the tubing draining liquids from the unit: it is disinfected by 97% of Polish dentists; more than half of them do this every day and almost 40% – once a week. Among those who do not use disinfection procedures, the most frequent cause of failing to do it is the lack of knowledge on the subject. It seems that the awareness of health risk created by patients' body fluids, fragments of tissues and fillings is much higher than their knowledge on the hazards related to microbiological contamination of water in the unit reservoir/container and in the tubing delivering water to handpieces.

Earlier studies of microbiological quality of water in DUWL, with special emphasis on aerobic and facultative anaerobic bacteria and the potential health risk created by opportunistic mesophile bacteria, indicate the necessity of an educational campaign among dentists in order to change the way they deal with dental unit water systems (30). However, appropriate materials to help dentists find the most rational methods – both economical and requiring minimum effort – of DUWL water microbiological quality control are lacking (26). Researchers emphasize that dentists need inexpensive, effective and safe disinfection products and/or methods for reducing the microbial load of water from DUWL, as well as correct procedure guidelines, adapted to the specificity and requirements of different regions/countries (23). It is also stressed that flushing water through waterlines is a simple measure that should become part of dental routine as a method to reduce the level of total bacteria in water (16,19). In addition, microbiological control of the quality of water should be routinely performed, and should include the detection of opportunistic pathogens (18).

CONCLUSION

In everyday dental practice, dentists fail to undertake measures that minimize and/or eliminate microbiological contamination of water in dental unit reservoirs. Dentists do not have sufficient knowledge about microbiological contamination of dental unit waterlines delivering water to working handpieces, about the principles of handling water and systems delivering water to handpieces, and about health risks created by microbiological contamination of dental unit water for the dental team and their patients. It is necessary to increase dentists' awareness concerning microbiological quality of water in dental units, as well as correct procedures of dealing with water and the tubing system delivering water to the dental unit working handpieces.

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