

## ORIGINAL RESEARCH ARTICLES

### ARE DENTISTS ENOUGH AWARE OF INFECTIOUS RISK ASSOCIATED WITH DENTAL UNIT WATERLINES ?

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#### Abstract

Environmental conditions in DU encourage biofilm development. This biofilm may represent a risk for patients and dental staff exposed to water and aerosols generated during dental cares, particularly for immunocompromised persons.

A survey was conducted on the 175 dental surgeons of the department of Vienne (France) to investigate the motivations of dental practitioners to renew their DU, their awareness levels with respect to infectious risks related to water circulating within DU, and methods used for the maintenance of DU waterlines.

These dentists were only partially aware of the need for maintaining DU waterlines. For this maintaining, chemical treatments and purges of pipes were carried out by 88% and 91.5% of dentists respectively ; chemical treatments were usually on a continuous mode and dentists seemed to have complete confidence in their DU supplier regarding the choice and the use of chemical treatments. Flushes were performed only once per day in most cases (63%). This survey also highlighted that dentists were not enough aware of water related infectious risk, even though 68% estimated that the development of a biofilm within DU waterlines was an actual risk. Finally, very positively, dentists strongly indicated their wish to be more informed regarding all these risks. Although these results are based on a relatively small sample, corresponding to dentists of a French department, they clearly suggest that awareness of dental surgeons is still insufficient and must be performed to permit an

effective prevention of infectious risk related to DU waterlines.

#### Keywords

dental unit, water, dental surgeons, infectious risk, biofilm, awareness

#### Introduction

The structure of walls tubing inside dental units (DU) promotes the development of a biofilm (1). DU design itself encourages the biofilm growth: thin wall tubing, minimal flow of water at the periphery of the lumen, stagnation of the entire water column for extended periods during the day, etc. (2-5). These factors contribute to reduce the quality of the water which originally came from the municipal water network. This may be worsened by a back-contamination of waterlines by microorganisms mixed with saliva traces coming from oral cavity of patients (6). This contamination occurs mainly because of the dysfunction or the poor maintenance of anti-retraction valves (4, 5).

The microbial contamination level of DU water is variable depending on the studies ( $10^2$  to  $10^6$  colonies/mL) (7) ; however, it is usually higher than the level recommended in French guidelines, which correspond to European standards of safe drinking water :  $<100$  colonies/mL at 22°C after 72h of cultivation, at the entrance of both the DU and hand-pieces, no variation greater than a ratio of 10 (guidelines of health French ministry, 2006) (8).

American Dental Association suggested a target level of less than 200 CFU/mL for the wa-

ter coming from oral mucosa of patients and the Centers for Disease Control and prevention recommend a similar level to that required for drinking water, less than 500 UFC/ ml (3). The functioning of DU hand-pieces generates aerosols from the intraluminal circuits of the machine which spread in both mouth and environment of patients and dental team (7). During dental care, these bioaerosols would contain between 1 and  $4 \cdot 10^5$  microorganisms /m<sup>3</sup> (9, 10). The diameter of particles forming aerosols may be less than 1 μm, inducing some risk of deep penetration of these particles in the respiratory tree of exposed people (10). Although very few cases of infections due to DU water have been proven (11-16), many studies emphasize the required control of water quality of DU and the need to make the conditions unfavorable to both microbial contamination of DU waterlines and microorganisms' proliferation (5, 17).

The cross infection risk, associated to the back-contamination of DU waterlines from both water and bioaerosols, is to be considered, especially for immunocompromised patients (1, 18, 19).

In agreement with the French National Order of Dentists of the departement of Vienne (France), our aim was to investigate the motivations of dentists to renew their DU, the methods used for maintenance of DU waterlines, and the awareness levels of dentists with respect to infectious risks associated with water circulating within DU.

### Materials and Methods

The evaluation was conducted by a questionnaire that was mailed in May 2009 to the 167 dental surgeons and 8 dental surgeons skilled in dentofacial orthopedics of the French department of Vienne. A letter to explain the context of this survey was associated with the questionnaire as well as a return envelope pre-filled to facilitate the return of questionnaires. No recovery has been completed and all returned questionnaires before September were taken into account. The data were then collected and processed using excel software.

### Results and Discussion

Among the 175 sent questionnaires, 171 reached their destination and four were returned due to bad addresses ; we received 60 filled questionnaires, representing a response rate of about 35% ; the filled questionnaires were

all from dental surgeons without specific dentofacial orthopedics practice.

First, we investigated the motivations leading the dentists to renew their DU. There were more than one DU in 61% of dental offices (n=59), with one or more dental practitioners working in these offices. The age of DU was most of the time (71%) less than 8 years (n=57) (Figure 1).

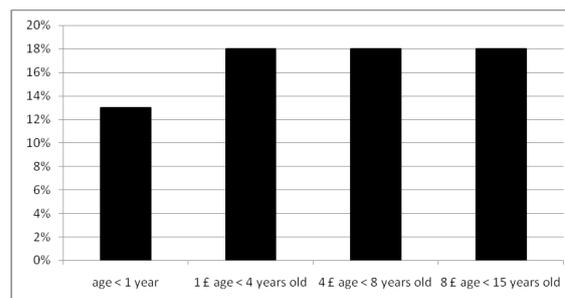


Figure 1 : Age of the dental units used by the dentists surveyed

Dentists' motivations to change their units are multiple. Actually, 97 answers were obtained corresponding to 57 filled questionnaires ; innovativeness was the primary motivation. Indeed, in 51.6% of cases, dental partitioners reported changing their hardware to access new technologies in terms of health care practices and hygiene (easy and effective maintenance). Failure or visual deterioration of the former unit motivates DU replacing in 34% of cases. Comfort for the patient, preventive renewal, dental office aesthetics and dental office moving were also mentioned occasionally (Figure 2, column "other"). However, no dentist referred to the age of the unit.

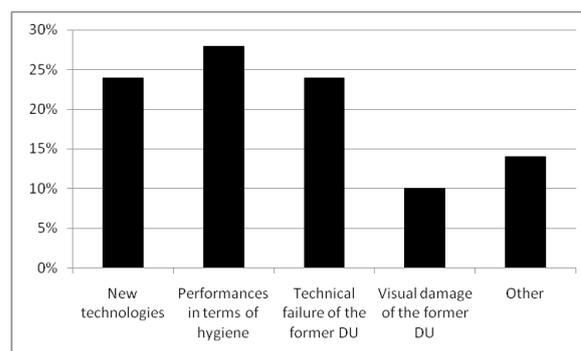


Figure 2 : Motivations of surgeons to change their former dental unit

Maintenance procedures of units' tubing were examined. Two approaches were investi-

gated. The first one was based on physical and chemical treatments of the units' water. Regarding the inner structure of DU allowing the treatment of the water delivered to the patient's mouth, dental surgeons reported the presence of an integrated water softener in 10% of cases (n=59) and the presence of filters in 21% of cases (n=47). The nature of filters was variable: active charcoal, membranous, etc. However, information provided by dentists did not allow a detailed analysis of this aspect. Dentists seemed to rely strictly on the recommendations of DU manufacturer regarding both nature and change frequency of filters, without real interest in both functioning principles and usefulness of these filters. DU in dental offices (n=60) had an inner water supply in 42% of cases. However, 6% of practitioners were not able to determine if their unit included or not such a water supply.

DU water was mainly treated using chemicals ; among the 59 dental surgeons who answered this question, 88% reported performing a chemical treatment. In 79% of cases, there was a continuous chemical treatment used alone (for 24 of 44 dentists) or associated to a periodic treatment (for 11 of 44 dentists). In other cases (21%), dentists said that they conducted only periodic chemical treatments of the DU waterlines. The type of chemical agent, its dosage, frequency and duration of treatments depended on the recommendations of the unit manufacturer. During an audit conducted by Chate (2010) in the East of England between 2006 and 2008, this practice was also assessed with 264 dentists. Chate reported that 50% of DU were chemically treated and highlighted that an agent with only disinfectant properties was used in all cases. Except for physical and chemical treatments of DU water that may be related both to local environmental conditions (residual chlorine in tap water, softening and/or filtration of the tapwater within the dental office,...) and to the type of DU in the dental office (model, manufacturer, age,...), we wished to assess compliance with French Ministry guidelines. Indeed, the latter recommend, for the prevention of microorganisms proliferation in DU waterlines, a purge of at least five minutes at the start of each day of use and a shorter purge (20 to 30 seconds) between two patients.

The second approach we investigated concerned the purges of DU waterlines. Results showed that 91.5% of the dentists surveyed (n=59) were implemented purges enginee-

ring. However, in most cases (63%), a single purge was carried out only once a day. A large range was observed in the dentists' practice,

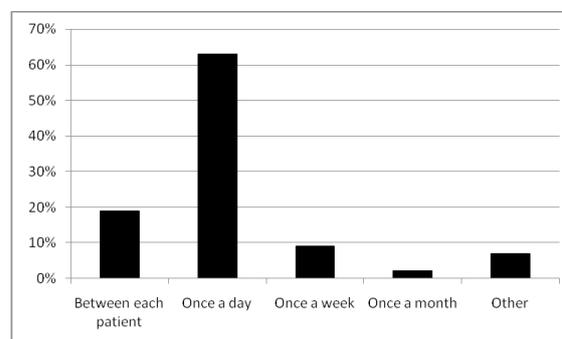


Figure 3 : Purging frequency of dental unit waterlines  
These results corresponded to 54 dentists surveyed

as shown in Figure 3. Two surveys conducted by questionnaire in South Africa also addressed this issue. Rudolph and Ogunbodede (1999) established that 76% of dentists were conducting a purge of DU pipes after each patient. Moreover, de Koch and van Wyk (2001), based in particular on US recommendations, reported that 50% of dentists surveyed were making a systematic purge of DU waterlines for three minutes at the beginning of each day and for 30 seconds between each patient(20). In its audit, Chate (2010) reported that 56% of DU were flushed at the beginning of each day for two minutes and only 29% were flushed between two patients for 20 seconds(21). Thus, results obtained in our survey are comparable to those of Chate.

Dentists were also surveyed to determine the origin of information that guided the choice of the techniques they used for DU waterlines maintenance. For this issue, we obtained seventy replies from 55 dental surgeons ; most dental practitioners (68.5%) reported using the manufacturer instructions as a source of information for equipment maintenance. Other information sources mentioned (31.5%) were divided into: the French Ministry of Health (14.2%), the French National Dental Council (10%) and other unspecified sources (7.1%). In our survey, dentists could indicate several answers.

Awareness of the risk of DU water contamination and of the infectious risk this latter potentially induced for patients were also investigated in our survey (Table 1). The development of a biofilm within the DU was considered to be an actual risk for 68% of dentists who answered (n=57). However dentists had a divi-

ded opinion on the fact that there was a potential infectious risk caused by DU water and only 28% of them were sure of the existence

	Yes	No	Not known
Risk for the development of a bio-film in DU (n=57)	68%	11%	21%
Infectious risk related to DU water for patients (n=58)	28%	34%	38%
Dentists' desire of being more informed (n=57)	90%	5%	5%

Table I. Self-assessment of risk by dentists: water microbial contamination and infectious risk for patients

of such risk (Table 1).

Of the 59 dentists from Vienne department of France who rated their awareness level with respect to infectious risk associated with DU water, 42.3% considered themselves to be "moderately" aware and more than one dentist in three (37.2%) felt "weakly" or "not" aware. Only 20.3% of dentists considered themselves "well" or "very well" aware. The major sources of information related to dental practice, and all that can result from, were identified by dental surgeons (n=48) ; those were firstly specialized press (41.7%) and DU suppliers (29.1%). French Health Ministry and French National Order of Dentists accounted for only 6.3% and 8.8% of responses respectively. On the other hand, dentists, in 90% of cases (n=57), expressed the wish to be more informed about infectious risks related to water in dental care context ; they suggested different ways for that information: mailing, e-mailing, press and French National Order of Dentists were mentioned equally by surveyed dentists (n=54). During the investigation of de Koch and van Wyk (2001) only 50% of dentists expressed the wish to improve their knowledge on the management of infectious risk associated to dental care(20).

Our survey thus highlighted that dental surgeons from the French department of Vienne were not enough informed and made aware of the infectous risk associated to DU water before attending that survey, even though the development of a biofilm within DU waterlines

seemed well established for a large majority of them. It was very positive to note that answers strongly indicated their wish to be more and/or better informed regarding these risks. It was also interesting to note that 41 of 60 assessed dentists provided their personal or professional e-mail address with the specific aim to get the results of this survey. Questionnaires being anonymous, they were entitled to refuse to give their contact details, which confirmed their motivation to be more and/or better informed.

Microbiological contamination of DU waterlines may cause infections, especially bacterial or fungal infections, among the most fragile patients. The development of a biofilm is unavoidable as soon as there is a liquid flow (water, mud, blood, food, etc.), in an inert equipment or circuit. Given the current state of knowledge on biofilms and their implications for human health, it is critical to sensitize dentists and more generally all the dental practitioners to these concerns. Continuing medical education for dentists and dental surgeons could allow updating of knowledge related to infectious risks related to water in dental care context. It could be done together with or in addition to other communication modes (French National Order of Dentists, national and international press...).

Dentists surveyed appeared at least partially aware of the need for maintaining DU waterlines. For most of responding practitioners, this maintaining involved a chemical treatment (usually on a continuous mode) and a flush of standing water from pipes. Regarding chemical treatments, practitioners appeared to have complete confidence in their DU supplier. Our study demonstrates that flushes were performed only once per day in most cases, which is far below the current recommendations.

In conclusion, although our results are based on the analysis of only 60 responses, on a small area (a French department), they strongly suggest that effective prevention of infectious risk related to DU waterlines will require information and awareness of dental professionals that is still insufficient ; these steps will enable practitioners to include effective prophylactic methods in their daily dental practice.

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