Title: Occupational exposure of dentists to extreme-low-frequency magnetic field

Running head: Magnetic field exposure of dentists

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Abstract

Objective: To compare occupational exposure to extremely-low-frequency magnetic field (ELF-MF) between dentists practicing in dental clinics and those employed in hospitals.

Methods: Thirty-two dentists who worked at clinics (n=15) and 33 dentists employed at hospital dental departments (n=7) voluntarily provided their informed consent to participate in this measurement study. The study dentists were requested to wear an ELF-MF dosimeter for some 3 hours at work to determine their personal exposure. Spot measurements taken at a number of locations in each dental office were used to indicate work environmental exposure level. Additionally, ELF-MF emitted from common dental equipments was also measured. All measurements were performed ~~by using~~ with EMDEX Lite meters.

Results: The average environmental exposure to ELF-MF is higher in clinic dental office than in hospital dental department (0.55 ~~micro-Tesla~~ (μT) vs 0.15 μT, p= 0.008). Personal dosimetry showed that in average, clinic dentists ~~had~~ spent 35.71 % and 19.39% of time ~~spent~~ their at exposures above 0.3 μT and 0.4 μT at work, respectively. The corresponding figures for hospital dentists were 19.61% and 13.92%. Additionally, ELF-MF was greater than 0.4 μT at 30 cm from all selected equipments, but the ELF-MF generally diminished as the distance from dental equipments increased. Uultraviolet air sterilization system produced 3 times ~~higher~~ as much ELF-MF ~~than~~ as other dental equipments.

Conclusions: This study suggests a possibility of over-exposure of dentists to power frequency ELF-MF. Additionally, certain dental equipments may produce ELF-MF levels greater than 0.4 μT in areas where dentists usually ~~stay~~ work when treating patients.

Key words: dentist; extremely-low-frequency; electromagnetic fields; exposure assessment; occupational hazards

Introduction

While epidemiologic evidence tends to indicate an association between residential exposure to extremely-low-frequency magnetic field (ELF-MF) of 0.4 (micro-Tesla) μT or higher and increased risk of childhood leukemia, the World Health Organization monograph published in 2007 suggested that the possibilities of other health consequences in relation to ELF-MF exposure have not been ruled out[1], which called for more research in recent years. In 2010, Kroll et al. reported an increased (14% for leukemia and 34% for other cancer) but insignificantly estimated relative risk of childhood cancer for each 0.2-μT increase in magnetic field[2]. Additionally, a German case-control study in 2010 also looked into the association between parental occupational exposure to ELF-MF and childhood cancer[3]. Moreover, Gobba et al. examined natural killer (NK) activity in 52 workers exposed to different levels of ELF-MF in various activities. In higher exposed workers, the study observed a trend to reduce NK activity compared to low exposed, but the difference was not significant[4].

There has been concern with occupational ELF-MF exposure for electrical workers, and many blue-collar workers, because they are more likely than other workers to use high power electrical equipments[5]. Very few studies have focused on survey of ELF-MF in health care workers, who also have potential for ELF-MF exposure owing to their proximity to certain medical facilities during work period. In a study that assessed low frequency magnetic field exposures in a hospital, striking variance was found for onsite measurements of magnetic flux density (0.08 μT - 6.5 μT) and in workers' time-weighted average (TWA) exposures (0.12 μT -1.04 μT)[6]. A later study conducted in a pharmacy of a medical center observed average magnetic flux density between 0.06 μT and 0.22 μT, and full-shift TWA exposure of 0.50 μT and 0.65 μT for two pharmacists, respectively[7]. A much lower personal ELF-MF exposure, TWA arithmetic means lower than 0.12 μT, has been reported for other health workers, including physiotherapists, occupational therapists, physicians, nurses and medical radiographers[8,9]. Possible explanations for the marked discrepancy in field ELF-MF intensities and personal exposure levels of health workers found among studies may include different types and models of medical facilities and equipment operated by health care workers. However, biased estimates due to a small sample size, and different strategies of sampling and measurements can not be entirely ruled out for the observed discrepancy in ELF-MF encountered by health care workers.

Exposure to ELF-MF during work period as compared to other activities has been reported to be the highest in

daily overall exposure[8,9]. In an earlier report, Bohay et al. examined some potential sources and intensities of 60 Hz magnetic fields produced in the dental environment[10]. The magnetic fields associated with various dental equipment including ultrasonic scalers, amalgamators, composite light curing units, X-ray view boxes and chair lights were measured. The median 60 Hz field strengths varied among the different types of equipment tested, ranging from 0.12 to 0.22 μT. In view of recent concerns with respect to the possible effects of magnetic fields, the study by Bohay et al. suggested that exposures be minimized and the concept of prudent avoidance be employed[10]. Additionally, the UK Adult Brain Tumour Study examined 79 individuals and 25 companies for occupational and non-occupational exposures to ELF-MF. The results showed occupational exposure to be the main determinant of overall exposure. The highest average occupational exposures were found for security officers (0.78 μT), secretaries (0.48 μT) and dentists (0.42 μT)[8]. Moreover, a recent survey reported ELF-MF of individuals from 117 different occupations. Average exposure was significantly higher at work than at home. The average occupational exposures for dentists (geometric mean (GM)=0.29 μT), and dental nurses (GM=0.24 μT) were comparable to the exposures experienced by electricians/electrical fitters (GM=0.29 μT), but higher than personal assistants and secretaries (GM=0.10 μT), nurses (GM=0.08 μT), and software professionals (GM=0.09 μT). The survey was also conducted in three dentist's rooms, in the same practice building, and indicated that differing levels of exposure could be explained by alternative positioning of ELF-MF sources within the rooms[9]. Despite a potential for overexposure to ELF-MF in dentists, the ELF-MF intensity in dental settings has not been adequately documented[5, 6, 11]. Also, information on personal exposure to ELF-MF in dentists has been scarce. This report was therefore conducted to further assess occupational exposure of dentists to ELF-MF.

This study aimed to obtain profile of ELF-MF exposure of dentists. Additionally, in Taiwan, dentists usually practice in either hospitals or dental clinics, and these two settings are very dissimilar in areas. The space for dental clinics is usually limited; therefore the density of dental equipment, sources of ELF-MF, is expected to be higher in clinics than in the dental departments of hospitals. We separately assessed the ELF-MF exposure for dentists from these two settings. Moreover, we not only performed personal ELF-MF exposure measurements using personal dosimeters, but also performed onsite measurements of ELF-MF intensities in work places where dentists usually stay while treating patients. ELF-MF intensities emitted from some common dental equipment were also determined. Determination of environmental and personal exposures may be useful in addressing dentists' overall occupational

93 exposures to ELF-MF.

Materials and Methods

Study clinics, hospitals, and dentists

Between June 2008 and February 2009, a convenient sample of 15 dental clinics and 7 hospitals in northern Taiwan (Taipei City and Taipei County) were solicited for occupational exposure ~~of dentists~~ to ELF-MF. We started our measurement work at a clinic just beside the Fu-Jen Catholic University, Taipei, Taiwan. This clinic has been providing dental services for many Fu-Jen students and ~~faculties~~. With our request, the first participating dentist referred us to two of his friends, who are also dentists, for measurement ~~works~~ at their clinics. ~~Considering that the~~ research grant ~~allows~~ only some 60 dentists to be measured ~~in this research~~, we continued the ~~study dentists~~ solicitation process until 15 dental clinics agree to participate in this study. There were 39 dentists working in those 15 clinics and 32 (82%) agree to participate in our study. For hospital setting, we directly contacted 18 hospitals located in the same and neighboring districts as Fu-Jen University, and 11 of them accepted our solicited visits for measurement. Due to difficulties ~~in~~ time ~~arrangement~~, we completed measurements in only 7 hospitals, where 33 (94.3%) out of 35 dentists were personally measured. Thirty-three dentists employed in the 7 hospitals and 32 dentists from the 15 participating clinics also provided their informed consents ~~for~~ personal dosimetry. The research protocol ~~has been~~ reviewed and approved by the Institutional Review Board of Fu-Jen Catholic University, Taipei, Taiwan.

Personal dosimetry

The dentists were scheduled to receive some 3 hours of personal dosimetry ~~of ELF-MF~~ during a dental treatment session. After a brief instruction regarding how the personal measurements would proceed, each dentist was requested to wear an EMDEX Lite (Enertech Consultants, Campbell, California) on waist. In addition, one dental assistant help completed a preformatted log-book recording the exact time of starting dental treatment, ~~leaving~~ and ~~coming back while away from~~ the dental office ~~temporarily, and~~ removing the dosimeter when the treatment session was terminated. The dentists were asked to continuously wear the meter during the measurement period. The investigators went to the dental office after the dental session was over to terminate the measurements and retrieved the recorded data from dosimeters. Measurements were performed by standard EMDEX Lite meters. The

measurement accuracy was ±2% in the frequency band from 40 Hz to 1 kHz, and the sample rate was set at 4 seconds. All dosimeters were calibrated before their uses.

Measurement of work environment

The hospital dental department is greater than the dental clinics in area. The number of dental chairs in each dental department ranged from 3 to 10 with a mean±standard deviation (SD) of 8.43±3.51. The corresponding figures for dental clinics were 1 to 6 and 3.13±1.36 (p=0.001). An average number of 3.57±1.72 hospital dentists and 1.67±0.98 clinic dentists (p=0.005) were at work while measurements were conducted. The majority of clinics (66%) and hospital dental departments (94%) were measured during the summer of 2008 (i.e., June to September, 2008).

We also used EMDEX Lite meters to measure onsite levels of environmental ELF-MF intensity. Treatment areas and waiting areas were measured separately in considering that dental equipments are the main source of ELF-MF in dental offices and are usually located in treatment areas. For each waiting area, we selected the four corners and a number of arbitrarily selected seats for measurements. For each treatment area, in addition to the four corners, we also selected several locations frequently accessed by dentists for measurements. All measurement locations must be 1 m height from the floor and must be at least 1 m from the wall to avoid influences from configured wires in the wall[5]. Due to different sizes of dental offices, the number of measurements varied from 25 to 35.

Measurement of dental equipment

Four common dental equipments including dental chair unit, ultrasonic scaler, composite light curing unit, and ultraviolet air sterilization system, were selected for measurements. Selection of dental chairs was due to the fact that they are the common ELF-MF source accessed by dentists. Selections of the other three equipments were due to their larger consumption of electricity. We performed the measurements by following the protocol proposed by the IEEE for surveying controlled environment[13]. The IEEE standard requires that measurements be collected at various distances (e.g., 0, 10, 30, and 50 cm) from the ELF-MF sources. We measured ELF-MF at three locations with different heights above the ground, i.e., 30, 100 and 150 cm, to estimate the exposure for knee, waist, and hand, respectively. For each location, a total of 90 measurements were conducted within six minutes and a six-minute

averaging was calculated. We calculated the spatial average derived from the three series of measurements collected over a vertical surface at 30, 100, and 150 cm above the ground. The spatial averaging is calculated as:

$$[(\sum_{i=1}^{n} x_i^2) / n]^{1/2}$$

where x_i is the six-minute averaging magnetic field intensity[14].

Statistical analysis

Because the hospital dental departments are usually greater than the dental clinics in area, and may have more dental equipments in use simultaneously, dentists employed in hospitals and those who work in clinics may experience different magnetic field intensity level occupationally. We thus decided to performed analyses for hospital dentists and clinic dentists separately.

We first described characteristics between dentists employed in hospitals and clinic dentists. To account for the non-symmetric distributions of magnetic field intensity, we calculated geometric mean (GM) and geometric standard deviation (GSD), in addition to arithmetic mean (AM) and standard deviation (SD), to well summarize the exposure. The non-parametric Mann-Whitney *U* test was also used to compare the difference in mean exposure of both environmental and personal measurements between hospital dentists and clinic dentists. A *p* value less than 0.05 were considered statistically significant. The statistically analysis was performed by SAS 9.1 (SAS Institute, Cary, NC).

Results

Personal exposure

More than 60% of study dentists were males. Hospital dentists were older than clinic dentists (46.00±12.64 vs 37.25±12.32 years). Due to availability, most hospital dentists were measured during morning treatment sessions, whereas a large ~~amount~~ of clinic dentists were measured in the evening. The mean duration of personal measurement was similar for hospital and clinic dentists (3.07±0.61 vs 3.04±0.80 hours) (Table 1).

The average number of measurement ~~was~~ similar for both hospital dentists (2766±552) and clinic dentists (2735±720). The minimum and maximum exposure averaged over a treatment session ~~was~~ 0.06 and 0.90 μT, with an AM of 0.24±0.16 μT for hospital dentists. The corresponding figures for clinic dentists were 0.05 – 0.73 μT and 0.28±0.16 μT. The clinic dentists also had a higher mean percentage of time >0.3 μT (35.71% vs 19.61%) and a higher mean percentage of time >0.4 μT (19.39% vs 13.92%) than hospital dentists, but ~~such~~ differences were not statistically significant. (Table 2)

Environmental exposure

~~For~~ each dental office, 25 to 35 on-site spot measurements were performed, with a mean number of 27.86±9.89 and 28.33±15.29 for clinics and hospital dental departments, respectively. Table 2 shows mean environmental ELF-MF intensity of dental offices. The minimum and maximum overall ELF-MF in hospital dental departments was 0.07 μT and 1.30 μT, respectively. The corresponding figures for clinics were 0.13 μT and 5.03 μT. The AM environmental exposure was higher, but ~~in~~significantly, in clinic dental office than in hospital dental department (0.49±0.34 μT vs 0.25±0.18 μT, p=0.113). While ~~the~~ analysis was limited to the measurements taken ~~at~~ the treatment areas, we noted a significantly higher AM in clinic dental offices than in hospital dental departments (0.55±0.67 μT vs 0.15±0.08 μT, p= 0.008). On the other hand, similar ELF-MF exposure level ~~was~~ noted in waiting areas.

Magnetic field emitted from dental equipment

Probably due to variations in ~~dissimilar~~ age and model, we noted a substantial variation in maximum (i.e., taken at 0 cm away from sources) ELF-MF among dental chairs (0.19 to 58.36 μT), with an AM and GM of 13.11±12.40 μT and 8.09±0.33 μT, respectively. The maximum ELF-MF for ultrasonic scaler~s also showed a substantial variation, with an AM and GM of 48.25±5.91 μT and 7.01±1.96 μT, respectively. The AM/GM of maximum ELF-MF for composite light curing unit~s and ultraviolet air sterilization system ~~was~~ ~s were 19.15±16.93 μT / 5.43±1.75 μT and 23.77±11.87 μT / 22.23±0.17 μT, respectively. But these figures were based on only 3 composite light curing units and 2 ultraviolet air sterilization machines. (Table 4)

Table 4 also demonstrate~~d~~ s the ~~a~~ clear decreasing trend in ELF-MF as the distance from dental equipment~~s~~ increased. The AM/GM for dental chair unit~s was 0.46±0.37 μT / 0.36±0.20 μT at 30 cm, which is the distance dentists usually keep ~~stay~~ while treating patients. The corresponding figures for ultrasonic scaler~s were similar at 0.41±0.37 μT / 0.27±0.33 μT, but were greater for composite light curing unit~s (0.85±1.01 μT / 0.45±0.58 μT) and ultraviolet air sterilization system~s (1.51±0.78 μT / 1.41±0.17 μT).

Discussion

This study revealed that in average, during treatment sessions hospital dentists spent 20% and 14% of time at levels of ELF-MF exposure in excess of 0.3 μT and 0.4 μT, respectively; the corresponding figures for clinic dentists were even higher. Moreover, the average ELF-MF intensity was greater than 0.4 μT at 30 cm from all dental equipments, a distance that dentists usually have when performing treatments, suggesting potential over exposure of ELF-MF for dentists while operating various dental equipments.

Previous occupational studies assessed ELF-MF exposures associated with various jobs including dentists and dental nurses, using personal dosimeters[8-11]. The UK study[8] reported that dentists had the third highest mean exposure (time-weighted average [TWA], 0.42 μT) among various job titles, next to security officer (0.78 μT) and secretary (0.48 μT). Workers with the other job titles had mean exposures not higher than 0.20 μT except for dental nurses (0.30 μT). Personal ELF-MF exposure of dentists in our study was lower than that of UK dentists but higher than that associated with most occupational titles.

Levels of ELF-MF in dental environments have been measured by type of and distance from dental equipments in a few studies[10,15]. One prior study[10] has evaluated the ELF-MF intensities produced by ultrasonic scalers and light curing units, which were also measured in our study. In line with our observations, the ELF-MF levels were higher than 0.4 μT at 30 cm from both equipments when they were turned on. The intensity was generally consistent with previous findings[10]. It is noteworthy that in our study, the ELF-MF level at 30 cm from ultraviolet air sterilization system was 1.41 μT, more than 3 times higher than that from other dental facilities; the ELF-MF intensity moderately reduced to 0.9 μT at 50cm. Although limited in sample size, our observation still suggested that dentists should elude long-term operation of ultraviolet air sterilization system and stay away from it in order to avoid over exposure to ELF-MF.

In this study, exposure level obtained from environmental measurements was similar to that obtained from personal dosimetry for hospital dentists (AM: 0.25 vs 0.24 μT). But, the environmental ELF-MF level at dental offices was much higher than the level obtained from personal dosimetry of clinic dentists (AM: 0.49 vs 0.28 μT). One of possible explanations is the difference in areas between hospital dental departments and clinic dental offices.

Dental clinic offices are usually ~ed therefore

~~The later ones usually are~~ limited in space and the environmental ELF-MF level is more likely affects by ~~certain~~

~s ~s ~s ~s ~s are

sources of ELF-MF such as TV, computer, printer, air-conditioner and fan[16]. Air conditioners ~~were~~ commonly used

in summer ~~seasons~~ in Taiwan, and the highest levels of ELF-MF have been reported to occur in this season[17]. The

much higher environmental ELF-MF intensity observed in dental clinic offices, relative to exposure levels of personal

dosimetry of clinic dentists, might be because ~~at least to some extent, that~~ most of our survey was performed in

summer ~~time.~~ Moreover, we did not take into account the temporal variation of ELF-MF intensities in dental offices.

the performed ~s

Unlike ~~performing a~~ 3-hour personal dosimetry ~~monitoring~~ for dentists, we performed only short-term field survey

of in were made

~~for~~ environmental exposure which ~~recorded~~ 25 to 35 measurements of magnetic flux densities in each dental office.

~s

Previous studies have reported temporal variation in ELF-MF intensity during an 8-hour[7] and 24-hour period[18].

resulted in misrepresentation of

Failure to take into account the temporal variation in ELF-MF may have ~~misclassified~~ the true environmental

in ~s; however, have been the

exposure ~~at~~ dental office; ~~but~~ the exposure misclassification error would not be systematically different between

hospital and dental office environments. The temporal variability might also partly explain the discrepancy between

~s the

level of personal exposure and environmental intensity of ELF-MF in the dental clinics. Moreover, our study findings

were based on a volunteer sample of dentists, and the sample size was not considered large enough to assure external

s

validity, which ~~all~~ limited the generalizibility of our study findings.

to

The other limitation ~~for~~ our study was related to the selection of places for measurements and the measurement

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time period were not identical in the dental offices involved in our study, ~~which is~~ mainly due to practical reasons. All the

in this study were

hospital dental departments and clinical dental offices ~~included in our study~~ were solicited to participate, and they ~~are~~

used ~d

different in size and interior design. As such, although we ~~had~~ a standardize measurement protocol, we were unable to

field could

completely follow the measurement protocol in the ~~filed~~, and ~~can~~ only take the measurements at places where we were

allowed ~~to~~ access.

to adults of

Despite controversy about the possible adverse health effect ~~from~~ ELF-MF exposure ~~in adults,~~ reducing

occupational ELF-MF exposure of dentists is of importance as their exposure is on a daily basis. Equipment such as

~s are

ultraviolet air sterilization system, which emits high ELF-MF levels and is not a built-in element of the main dental

unit, can be placed away from dentists' working area. In addition, ELF-MF magnitude has been reported to be

Limitation of

dissimilar among different models and types of dental instruments[15]. ~~Avoid~~ utilization or appropriate allocation of

when ~s

those models that ~~may~~ emit high ELF-MF intensity should be considered while setting up dental work station in

to limit dentists'

order ~~for avoidance of over~~ exposure to ELF-MF ~~in dentists.~~ In conclusion, it is possible for dentists to encounter overexposure to ELF-MF while treating their patients. Prudential avoidance to such ~~over~~exposure ~s can be achieved by positioning of appropriately ~~allocating the~~ dental equipment in the office.

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Table 1. Characteristics of the ~~study~~ dentists participating in this study

	Hospital dentists (N=33)		Clinic dentists (N=32)	
	n	%	n	%
Gender				
Male	21	63.6	21	65.6
Female	12	36.4	11	34.4
Age				
≦29	3	9.38	11	32.14
30 – 39	8	25.00	13	39.29
40 – 49	6	18.75	3	10.71
50 – 59	9	28.13	2	7.14
≧60	6	18.75	3	10.71
Mean±SD	46.00±12.64		37.25±12.32	
Month of measurement				
June, 2008	3	9.09	2	6.25
July, 2008	3	9.09	2	6.25
August, 2008	21	63.64	10	31.25
September, 2008	4	12.12	4	12.50
October, 2008	0	0.00	1	3.13
January, 2009	2	6.06	2	6.25
February, 2009	0	0.00	11	34.38
Time of measurement				
Morning	25	75.76	4	12.50
Afternoon	6	18.18	8	25.00
Evening	2	6.06	20	62.50
Duration of measurement				
<2	2	6.06	2	6.25
2 – <3	10	30.30	15	46.88
3 – <3.5	14	42.42	10	31.25
≧3.5	7	21.21	5	15.63
Mean±SD	3.07±0.61		3.04±0.80	

293 **Table 2.** Magnetic field intensity (μT) exposure of dentists at the time of performing dental treatment

Statistic[a]	Hospital dentists (N=33)	Clinic dentists (N=32)	*p* value
Average exposure			
Min. – Max.	0.06-0.90	0.05-0.73	
AM±SD	0.24±0.16	0.28±0.16	0.283[b]
GM±GSD	0.20±0.18	0.23±0.19	
% of time >0.3 μT			
Min. - Max.	0.00 – 91.71	0.20 – 99.96	
AM±SD	19.61±28.89	35.71±38.87	0.064 [b]
% of time >0.4 μT			
Min. - Max.	0.00 - 88.09	0.00 - 98.88	
AM±SD	13.92±25.90	19.39±31.70	0.448[b]

294 [a] AM=arithmetic mean; SD=standard deviation; GM=geometric mean; GSD=geometric standard deviation

295 [b] Mann-Whitney *U* Test

296 **Table 3.** Mean environmental magnetic field intensity (μT) of dental offices

Statistic[a]	Hospitals	Clinics	*p* value[b]
	n=7	n=15	
Overall			
Min. – Max.	0.07-1.30	0.13-5.03	
AM±SD	0.25±0.18	0.49±0.34	0.113
GM±GSD	0.18±0.12	0.25±0.14	
Treatment area			
Min. – Max.	0.08-0.34	0.14-2.51	
AM±SD	0.15±0.08	0.55±0.67	**0.008**
GM±GSD	0.14±0.07	0.27±0.13	
Waiting area			
Min. – Max.	0.17-0.55	0.22-0.14	
AM±SD	0.35±0.51	0.31±0.18	0.665
GM±GSD	0.30±0.43	0.29±0.17	

297 [a] AM=arithmetic mean; SD=standard deviation; GM=geometric mean; GSD=geometric standard deviation

298 [b] Mann-Whitney *U* Test

299 **Table 4.** Magnetic field intensity (μT) exposure of dentists at the time of performing dental treatment

	n	Distance from magnetic field source (cm)			
		0	10	30	50
Dental chair unit	29				
Min.		0.19	0.15	0.14	0.04
Max.		58.36	7.19	1.90	1.52
Median		9.63	2.14	0.38	0.31
AM±SD		13.11±12.40	2.48±1.87	0.46±0.37	0.32±0.31
GM±GSD		8.09±0.33	1.79±0.25	0.36±0.20	0.23±0.24
Ultrasonic scaler	15				
Min.		0.13	0.06	0.05	0.05
Max.		113.12	11.52	0.97	0.28
Median		14.68	2.97	0.39	0.15
AM±SD		48.25±5.91	4.4±4.78	0.41±0.37	0.16±0.10
GM±GSD		7.01±1.96	1.61±0.82	0.27±0.33	0.13±0.21
Composite light curing unit [a]	3				
Min.		0.20	1.20	0.13	0.06
Max.		32.80	11.24	1.56	0.25
Median		24.45	6.22	0.85	0.16
AM±SD		19.15±16.93	6.22±7.01	0.85±1.01	0.16±0.13
GM±GSD		5.43±1.75	3.67±0.49	0.45±0.58	0.12±0.27
Ultraviolet air sterilization system [b]	2				
Min.		15.37	4.84	0.96	0.61
Max.		32.16	16.08	2.06	1.34
Median		23.77	10.46	1.51	0.98
AM±SD		23.77±11.87	10.46±7.95	1.51±0.78	0.98±0.52
GM±GSD		22.23±0.17	8.82±0.23	1.41±0.17	0.90±0.18

300 [a] Ortholux XT Visible Light Curing Unit 3M UNITEK (n=2); Elipar™ S10 LED Curing Light, 3M ESPE (n=1)

301 [b] SAMPO MEDICAL T-378 (n=2)