



King Saud University
The Saudi Journal for Dental Research

www.ksu.edu.sa
www.sciencedirect.com



ORIGINAL ARTICLE

To what extent do dental students comply with infection control practices?

Noura A. AL-Essa^{*}, Manal A. AlMutairi

Faculty, Division of Pediatric Dentistry, Department of Pediatric Dentistry and Orthodontics, Dental College, King Saud University, Riyadh, Saudi Arabia

Received 21 June 2016; revised 7 October 2016; accepted 18 October 2016

KEYWORDS

Infection control;
Dental students;
Guidelines;
Practice

Abstract *Aim:* This study was conducted to evaluate knowledge, attitudes, and practices regarding infection control measures among dental students at the College of Dentistry, King Saud University, Riyadh, Saudi Arabia.

Methods: A self-administrated English-language questionnaire with questions related to hepatitis B vaccination and serology, the use of personal protective equipment, infection control practices and awareness, percutaneous and mucous membrane exposure, and attitudes toward the dental treatment of infected patients was distributed to third-fifth-year dental students. Responses were analyzed using SPSS, with a significance level of $p < 0.05$.

Results: The response rate was 83.4% ($n = 303$). Most (95.4%) students had received hepatitis B virus vaccination, but only 61.4% had completed the three doses, with a significant difference among academic years ($p = 0.000$). Almost all students always used gloves (99.3%), masks (98.7%), and gowns (95%) while treating patients. Fewer students always used face shields (69.6%) and head caps (65%), with significant differences between males and females. About two-thirds (65%) of participants reported injury with a used instrument; such injury was significantly more common among fifth-year students ($p = 0.041$). The most frequently reported injuries were caused by needles and burs (21.1%). Male students were significantly more willing than female students to treat patients with infectious diseases.

Conclusion: The dental students surveyed in this study showed satisfactory knowledge and positive attitudes regarding infection control. More effort is needed to provide proper training in ideal infection control measures for undergraduate students.

© 2016 The Authors. Production and hosting by Elsevier B.V. on behalf of King Saud University. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

^{*} Corresponding author at: P.O. Box 291563, Riyadh 11362, Saudi Arabia.

E-mail address: Dr.nnn@hotmail.com (N.A. AL-Essa).

Peer review under responsibility of King Saud University.



1. Introduction

Most infectious diseases that colonize the oral cavity and respiratory tract, such as hepatitis B virus (HBV), hepatitis C virus (HCV), human immunodeficiency virus (HIV), herpes simplex virus type 1, influenza, rubella, and other viruses and bacteria, can be transmitted in dental clinics. The high

<http://dx.doi.org/10.1016/j.sjdr.2016.10.003>

2352-0035 © 2016 The Authors. Production and hosting by Elsevier B.V. on behalf of King Saud University.

This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Please cite this article in press as: AL-Essa NA, AlMutairi MA To what extent do dental students comply with infection control practices?, *The Saudi Journal for Dental Research* (2016), <http://dx.doi.org/10.1016/j.sjdr.2016.10.003>

percentages of affected people worldwide increase the chance of their attendance at dental clinics,¹ and dental staff members, including dentists and dental students, are at high risk of exposure to and contraction of these diseases.^{2,3} For example, professionals in dentistry and oral hygiene are three times more likely than the general population to contract HBV infection.^{4,5}

In the clinical context, diseases can be transmitted through direct contact with blood, oral fluids, or other secretions, indirect contact with contaminated instruments, surgical equipment, or environmental surfaces, or contact with aerosols of oral and respiratory fluids of infected patients.^{2,6,7} Exposure to infected blood can result in disease transmission from patient to dentist, from dentist to patient, and from one patient to another. The opportunity for transmission from patient to dentist is greatest, as dentists are frequently in contact with patients' blood and blood-contaminated saliva during dental procedures. As some patients visiting dental clinics appear to be healthy, with normal physical examination findings and medical histories, the application of standard precautions should not be based on patients' appearance.⁸ By implementing infection control guidelines in addition to vaccinations and proper post-exposure management, exposure to infections in dental settings can be prevented. The guidelines for infection control in dental health care of the US Centers for Disease Control and Prevention recommend careful handling of sharp instruments, use of rubber dams to minimize blood spattering, hand washing, and use of protective barriers (e.g., gloves, masks, protective eyewear, and gowns).^{5,9} Few dentists, however, adhere to these guidelines.¹⁰

As dental students have less experience than do regular dentists, the implementation of standard universal precautions in dental schools is the most effective way to control cross-infection.^{11,12} Dental schools are responsible for applying appropriate infection control strategies and facilitating appropriate immunization to establish a healthy environment in which dental students and patients are protected.¹³

Dental education can play an important role in providing dentists with adequate knowledge and attitudes related to infection control measures. At the College of Dentistry of King Saud University, Riyadh, Saudi Arabia, students apply the concepts of infection control in clinical training sessions. The clinics provide disposable caps, gowns, gloves, and protective eyewear or face shields, and rubber dam use with all patients is mandatory. Students are required to be vaccinated against HBV before starting to treat patients. The purpose of this study was to investigate knowledge, attitudes, and practices regarding infection control measures among dental students at the College of Dentistry, King Saud University.

2. Methods

Approval for this study was obtained from the College of Dentistry Research Center at King Saud University. Dental students participated voluntarily and provided informed consent. Third-, fourth-, and fifth-year dental students, who attend clinics and treat patients, were invited to participate in this study. Training in infection control at the College of Dentistry is provided mainly in the first and second years.

A self-administrated English-language questionnaire consisting of 21 close-ended questions related to HBV vaccination and serology, the use of personal protective equipment, infection control practices and awareness, percutaneous and mucous membrane exposure, and attitudes toward the dental treatment of infected patients was created for this study. To evaluate the ease of reading, clarity of wording, and understanding of the questions, the questionnaire was administered to 20 students in a pilot study, and a few modifications were introduced. The students who participated in the pilot study were not included in the final sample.

A total of 363 dental students (third year, $n = 132$; fourth year, $n = 132$; fifth year, $n = 99$) were given the questionnaire in the classroom and asked to fill it out without discussing it with their friends. Completion of the questionnaire took about 5–10 min. Data from all returned questionnaires were entered and analyzed using SPSS 20.0 (IBM Corporation, Armonk, NY, USA). Frequencies and percentages were calculated, and the chi-squared test was used to assess associations between variables. The level of statistical significance was set to $p < 0.05$.

3. Results

The study sample comprised data from 303 third- ($n = 103$), fourth- ($n = 106$), and fifth-year ($n = 94$) students [156 (51.5%) male, 147 (48.5%) female] at the College of Dentistry, King Saud University (response rate, 83.4%; Table 1). Most (95.4%) students had received HBV vaccination, with no significant difference according to gender or academic year. Only 61.4% of them, however, had completed the three recommended doses of the HBV vaccine, with significant differences favoring males over females and fifth-year over third-year students (both $p < 0.05$ Table 2). In total, 45.8% of the students had undergone post-HBV immunization; significantly more males than females had taken this measure ($p < 0.05$; Table 2).

Almost all of the students always used gloves (99.3%), masks (98.7%), and gowns (95%) while treating patients. Fewer students always used face shields (69.6%) and head caps (65%), with significant differences according to academic level

Table 1 Distribution of the students based on gender and academic year.

Gender		<i>n</i>	%
Males		156	51.5
Females		147	48.5
Total		303	100
Academic year			
3rd year	Males	54	52.4
	Females	49	47.6
	Total	103	100
4th year	Males	51	48.1
	Females	55	51.9
	Total	106	100
5th year	Males	51	54.3
	Females	43	45.7
	Total	94	100

Table 2 HBV vaccination status according to gender and academic year.

Variable	Academic year			Total (%)	P-value	Gender		P-value
	3 rd (%)	4 th (%)	5 th (%)			Males (%)	Female (%)	
HBV vaccine						156	147	
Yes	95 (92.2)	101 (95.3)	93 (98.9)	289 (95.4)	0.081	152 (97.4)	137 (93.2)	0.079
No	8 (7.8)	5 (4.7)	14 (4.6)	14 (4.6)		4 (2.6)	10 (6.8)	
No. of doses								
3	41 (39.8)	70 (66)	75 (79.8)	186 (61.4)	0.000*	114 (73.1)	72 (49)	0.000*
< 3	50 (48.5)	18 (17)	10 (10.6)	78 (25.7)	0.000*	30 (19.2)	48 (32.7)	0.008*
> 3	2 (1.9)	1 (0.9)	3 (3.2)	6 (2)	0.522	2 (1.3)	4 (2.7)	0.369
Don't remember	3 (2.9)	15 (14.2)	6 (6.4)	24 (7.9)	0.009*	8 (5.1)	16 (10.9)	0.064
Post-HBV serology	46 (44.7)	48 (45.3)	44 (46.8)	138 (45.5)	0.953	98 (62.8)	40 (27.2)	0.000*

* Significant.

Table 3 Protective barrier use according to gender and academic year

Variable	Academic year			Total (%)	P-value	Gender		P-value
	3 rd (%)	4 th (%)	5 th (%)			Males (%)	Female (%)	
Gloves								
Always	103 (100)	104 (98.1)	94 (100)	301 (99.3)	0.154	154 (98.7)	147 (100)	0.168
Sometimes	0	2 (1.9)	0	2 (0.7)		2 (1.3)	0	
Never	0	0	0	0		0	0	
Masks								
Always	101 (98.1)	104 (98.1)	94 (100)	299 (98.7)	0.402	152 (97.4)	147 (100)	0.051
Sometimes	2 (1.9)	2 (1.9)	0	4 (1.3)		4 (2.6)	0	
Never	0	0	0	0		0	0	
Eyewear, face shield								
Always	74 (71.8)	83 (78.3)	54 (57.4)	211 (69.6)	0.003*	95 (60.9)	116 (78.9)	0.002*
Sometimes	25 (24.3)	23 (21.7)	39 (41.5)	87 (28.7)		57 (36.5)	30 (20.4)	
Never	4 (3.9)	0	1 (1.1)	5 (1.7)		4 (2.6)	1 (0.7)	
Gown								
Always	100 (97.1)	101 (95.3)	87 (92.6)	288 (95)	0.461	148 (94.9)	140 (95.2)	0.537
Sometimes	3 (2.9)	5 (4.7)	6 (6.4)	14 (6.4)		8 (5.1)	6 (4.1)	
Never	0	0	1 (1.1)	1 (0.3)		0	1 (0.7)	
Head cap								
Always	75 (72.8)	71 (67)	51 (54.3)	197 (65)	0.003*	112 (71.8)	85 (57.8)	0.000*
Sometimes	14 (13.6)	18 (17)	33 (35.1)	65 (21.5)		41 (26.3)	24 (16.3)	
Never	14 (13.6)	17 (16)	10 (10.6)	41 (13.5)		3 (1.9)	38 (25.9)	

* Significant.

and gender (both $p < 0.05$; Table 3). The majority (99.7%) of students changed their gloves between patients, but only 67% of them washed their hands at each change (Table 4). Most (91.1%) participants removed their gloves while walking around out of their clinics, but only 39.3% removed their masks. Most (80.2%) students removed their jewelry and watches before starting treatment, with no significant difference according to academic year or gender. In addition, the majority (93.4%) of students agreed with the removal of contaminated gowns or lab coats; this response was predominant among third-years students (98.1%), but the difference among academic years was not significant (Table 4).

A high percentage (90.1%) of students believed that the risk of infection was greater in dental clinics than in medical clinics; this belief was significantly more pervasive among third-year students ($p < 0.05$; Table 4). About two-thirds (65%) of the participants reported percutaneous injury with a used instrument; significantly more fifth-year than third-year students

reported such injuries (73.4% vs. 56.3%, $p < 0.05$; Table 4). Injury with needles and burs was reported most frequently (21.1%), followed by injury with endodontic files (18.2%; Fig. 1).

Only 66.7% of the students showed positive attitudes toward the treatment of patients with infectious diseases; significantly more males than females were willing to treat such patients (76.9% vs. 55.8%, $p < 0.05$; Table 4). The majority (96.2%) of students wished to follow the infection control measures used in the college after graduation (Table 4).

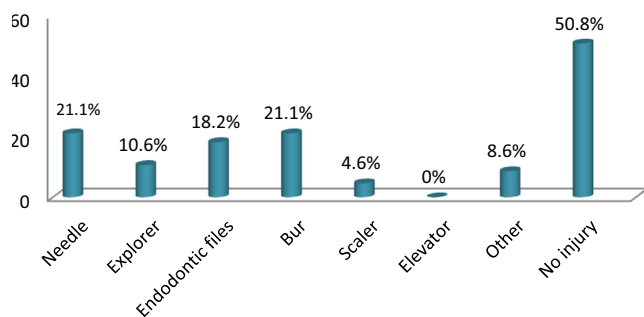
4. Discussion

Dentists have a very important community role, as they provide dental treatment and promote oral health, but they are at high risk of infection and cross-contamination, as they deal with saliva and blood and use sharp instruments.^{10,14-16}

Table 4 Students' practices and attitudes regarding infection.

Variable (yes)	Level			Total (%)	P-value	Gender		P-value
	3 rd (%)	4 th (%)	5 th (%)			Males (%)	Female (%)	
Change gloves between patients	102 (99)	106 (100)	94 (100)	302 (99.7)	0.378	156 (100)	146 (99.3)	0.302
Wash hands between each glove change	75 (72.8)	72 (67.9)	56 (59.6)	203 (67)	0.138	105 (67.3)	98 (66.7)	0.906
Remove gloves while walking around	89 (89.4)	101 (95.3)	89 (91.5)	276 (91.1)	0.078	139 (89.1)	137 (93.2)	0.211
Removal of mask while walking around	46 (44.7)	34 (32.1)	39 (41.5)	119 (39.3)	0.153	64 (41)	55 (37.4)	0.520
Change gown/lab coat if visibly contaminated	101 (98.1)	97 (91.5)	85 (90.4)	283 (93.4)	0.061	143 (91.7)	140 (95.2)	0.211
Dental clinics more conducive to infectious disease transmission than clinics in other medical fields	98 (95.1)	97 (91.5)	78 (83)	273 (90.1)	0.014*	138 (88.5)	135 (91.8)	0.326
Sterilize instrument after each dental procedure	103 (100)	103 (97.2)	93 (98.9)	299 (98.7)	0.194	154 (98.7)	145 (98.6)	0.952
Remove of watch and jewelry during procedures	88 (85.4)	86 (81.1)	69 (73.4)	243 (80.2)	0.102	124 (79.5)	119 (81)	0.749
Percutaneous injury with a used instrument	58 (56.3)	70 (66)	69 (73.4)	197 (65)	0.041*	116 (74.4)	81 (55.1)	0.000*
Willing to treat patients with infectious disease	70 (68)	70 (66)	62 (66)	202 (66.7)	0.943	120 (76.9)	82 (55.8)	0.000*
Ever treated patient with infectious disease	24 (23.3)	32 (30.2)	34 (63.2)	90 (29.7)	0.141	47 (30.1)	43 (29.3)	0.867
Willing to follow the infection control used in your college in the future (after graduation)	96 (93.2)	103 (97.2)	92 (97.9)	291 (96)	0.186	150 (96.2)	141 (95.9)	0.916

* Significant.

**Fig. 1** Injuries caused by different instruments.

Infection control in dental clinics is thus important to prevent disease transmission.

The finding that nearly all students in the present study had received HBV vaccination, but that fewer of them had completed the recommended three doses, is similar to findings from dental schools in Jordan (95% vaccinated),¹⁷ United Arab Emirates (UAE; 95.8% vaccinated, 64.7% completed doses),¹⁸ Saudi Arabia (90% vaccinated, 74% completed doses),¹⁹ Brazil (90.8% vaccinated, 80.3% completed doses),⁸ and Yemen (71% vaccinated, 50% completed doses).²⁰ The percentage of students who completed the recommended number of doses in Brazil is higher than that found in the present study. In addition, more fifth-year than third-year students in the present study completed the HBV doses because the latter were just beginning to treat patients and had received the first dose; time is required between each dose administration. Less than half of students in this study reported post-HBV immuniza-

tion, similar to the findings of Rahman et al.¹⁵ and Qudeimat et al.¹⁷

The high compliance with the use of gloves, masks, and gowns reported in this study is similar to the findings of previous studies conducted in the UAE,¹⁸ Saudi Arabia,¹⁹ Canada,²¹ and Jordan.¹⁷ About two-thirds of students reported the use of protective eyewear at all times; this percentage is similar to findings from Germany (64%)²² and Bulgaria (67%),²³ higher than observed previously in Saudi Arabia¹⁹ and the UAE,¹⁸ and lower than found in Brazil (84.2%) and Canada (93.5%).^{8,21} This result indicates insufficient understanding of the importance of eye protection, given the chance of disease transmission through aerosols and blood. More students in the present study reported compliance with the use of head caps than reported by Rahman et al.¹⁸ Several studies have shown that pathogens on contaminated clinical clothing remain alive for several days;^{24,25} almost all students in the present study reported wearing gowns while treating their patients and changing visibly contaminated lab coats or gowns.

Among dental personnel, hand hygiene is very important to limit infection of patients; it is considered to be one of the most effective methods of infection control.¹⁴ Although nearly all students in the present study reported changing gloves between patients, only two-thirds reported washing their hands between glove changes. This percentage is similar to that reported by Al-Maweri et al.¹⁹ and higher than reported by Rahman et al. (45%),¹⁸ de-Amorim-finzi et al. (45%),²⁶ and de Melo and Gontijo (43%).²⁷

Consistent with previous findings,^{18,20} the majority of students in the present study believed that the risk of infection was greater in dental clinics than in medical clinics. Dentists are more prone to infection because of contact with blood and saliva.²⁵

The percentage of students reporting non-sterile injury while working in this study is similar to those found in the UAE¹⁸ and Yemen;²⁰ higher than in similar studies conducted in Brazil,⁸ Jordan,¹⁷ and Saudi Arabia;¹⁹ and lower than found among students in Canada (80%).²¹ Anesthetic needles were the main source of injury, similar to previous findings.^{18,21} Younai et al.²⁸ stated that sharp injuries are more common in dentistry than in other health professions. The reporting of more injuries among fifth-year than among third-year students can be attributed to the longer clinical exposure of the former.

Most students in the present study reported removing their jewelry and watches before performing dental procedures. Large numbers of bacteria have been isolated under rings and watches, and hand washing without rings achieves more effective bacterial reduction.^{29,30} Similar to other findings, only about two-thirds of students in the present study showed positive attitudes toward the treatment of patients with infectious diseases.^{18,19}

Although the results of the present survey provided information about students' knowledge regarding infection control; including more students in private sectors and other governmental sectors could help to have valuable knowledge about infection control among Saudi dental students.

5. Conclusions

The findings of this study highlight the importance of educating dental students about infection control measures and recent relevant guidelines. This study was conducted to assess infection control measures used by students, planning to reduce cross-contamination in dental clinics. In addition to successful dental treatment, the provision of a healthy dental environment is important for health care providers and patients. Proper academic training with instruction in ideal infection control measures for undergraduate students will lead to the implementation of appropriate strategies by future dentists.

Conflict of interest

None declared.

Acknowledgments

The authors would like to thank the students of the College of Dentistry, King Saud University, for their participation in this research. The study was registered at the College of Dentistry Research Center (FR0269), King Saud University, Riyadh, Saudi Arabia.

References

- Alavian SM, Mahboobi N. Hepatitis B infection in dentistry setting needs more attention. *Med Princ Pract* 2011;**20**:491–2.
- Milward MR, Cooper PR. Competency assessment for infection control in the undergraduate dental curriculum. *Eur J Dent Educ* 2007;**11**:148–54.
- Santosh K, Jyothi S, Prabu D, Suhas KK. Infection control practices among undergraduate students from a private dental school in India. *Rev Odonto Ciênc* 2009;**24**:124–8.
- Barberis M, Brenna Betti N, Lauritano D, Salvato A, Spadari F, Villa S. HIV infection. The risks for health providers and prevention and control measures. *Minerva Stomatol* 1994;**43** (6):279–87.
- Centers for Disease Control and Prevention. Guidelines for infection control in dental health care settings; 2003.
- Shah R, Collins JM, Hodge TM, Laing ER. A national study of cross infection control: 'Are we clean enough?'. *Br Dent J* 2009;**207** (6):267–74.
- Lin SM, Svoboda KK, Giletto A, Seibert J, Puttaiah R. Effects of hydrogen peroxide on dental unit biofilms and treatment water contamination. *Eur J Dent* 2011;**5**:47–59.
- de Souza RA, Namen FM, Galan Jr J, Vieira C, Sedano HO. Infection control measures among senior dental students in Rio de Janeiro State, Brazil. *J Public Health Dent* 2006;**66**(4):282–4.
- Utomi IL. Attitudes of Nigerian dentists towards hepatitis B vaccination and use of barrier techniques. *West Afr J Med* 2005;**24**:223–6.
- Su J, Deng XH, Sun Z. A 10-year survey of compliance with recommended procedures for infection control by dentists in Beijing. *Int Dent J* 2012;**62**(3):148–53.
- Kohn WG, Collins AS, Cleveland JL, Harte JA, Eklund KJ, Malvitz DM. Centers for Disease Control and Prevention (CDC). Guidelines for infection control in dental health care settings – 2003. *MMWR Recomm Rep* 2003;**52**:1–61.
- Freire DN, Pordeus IA, Paixão HH. Observing the behavior of senior dental students in relation to infection control practices. *J Dent Educ* 2000;**64**:352–6.
- Mosley JW, Edwards VM, Casey G, Redecker AG, White E. Hepatitis B virus infection in dentists. *N Engl J Med* 1975;**293**:729–34.
- Mutters NT, Hägele U, Hagenfeld D, Hellwig E, Frank U. Compliance with infection control practices in an university hospital dental clinic. *GMS Hyg Infect Control* 2014;**9**(3), Doc18.
- Askarian M, Mirzaei K, Assadian O. Iranians' attitudes about possible human immunodeficiency virus transmission in dental settings. *Infect Control Hosp Epidemiol* 2007;**28**(2):234–7.
- Pagliari AV, Garbin CAS, Garbin AJI. HIV attitudes and practices among professors in a Brazilian dental school. *J Dent Educ* 2004;**68**(12):1278–85.
- Qudeimat MA, Farrah RY, Owais AI. Infection control knowledge and practices among dentists and dental nurses at a Jordanian University Teaching Center. *Am J Infect Control* 2006;**34**(4):218–22.
- Rahman B, Abraham SB, Alsalami AM, Alkhaja FE, Najem SI. Attitudes and practices of infection control among senior dental students at college of dentistry, university of Sharjah in the United Arab Emirates. *Eur J Dent* 2013;**7**(Suppl. 1):15–9.
- Al-Maweri SA, Tarakji B, Shugaa-Addin B, Al-Shamiri HM, Alaizari NA, AlMasri O. Infection control: knowledge and compliance among Saudi undergraduate dental students. *GMS Hyg Infect Control* 2015;**10**, Doc10.
- Halboub ES, Al-Maweri SA, Al-Jamaei AA, Tarakji B, Al-Soneidar WA. Knowledge, attitudes, and practice of infection control among Dental Students at Sana'a University, Yemen. *J Int Oral Health* 2015;**7**(5):15–9.
- McCarthy GM, Britton JE. A survey of final-year dental, medical and nursing students: occupational injuries and infection control. *J Can Dent Assoc* 2000;**66**:561.
- Kramer A, Meyer G, Ertzinger S, Kietz K, Schrader O, Martiny H. Multicenter study on the realization of selected hygiene measures in 331 dental practices. *Hyg Med* 2008;**33**(3):64–73.
- Balcheva M, Panov VE, Madjova Ch, Balcheva G. Occupational infectious risk in dentistry – awareness and protection. *J IMAB* 2015;**21**(4):995–9.
- Qureshi UM, Siddiqui S, Macfarlane TV. Cross infection: how do dentists change into a clean set of clinical clothing? *Health Educ J* 2005;**64**:101–9.

25. Bentley CD, Burkhart NW, Crawford JJ. Evaluating spatter and aerosol contamination during dental procedures. *J Am Dent Assoc* 1994;**125**:579–84.
26. de Amorim-Finzi MB, Cury MV, Costa CR, Dos Santos AC, de Melo GB. Rate of compliance with hand hygiene by dental healthcare personnel (DHCP) within a dentistry healthcare first aid facility. *Eur J Dent* 2010;**4**:233–7.
27. de Melo GB, Gontijo Filho PP. Survey of the knowledge and practice of infection control among dental practitioners. *Braz J Infect Dis* 2000;**4**:291-5
28. Younai FS, Murphy DC, Kotelchuck D. Occupational exposures to blood in a dental teaching environment: results of a ten-year surveillance study. *J Dent Educ* 2001;**65**(5):436–48.
29. Field EA, McGowan P, Pearce PK, Martin MV. Rings and watches: should they be removed prior to operative dental procedures? *J Dent* 1996;**24**:65–9.
30. Salisbury DM, Hutfilz P, Treen LM, Bollin GE, Gautam S. The effect of rings on microbial load of health care workers' hands. *Am J Infect Control* 1997;**25**:24–7.