

Knowledge of cross-contamination control among clinical fixed prosthodontic students at the faculty of dentistry, Omer-Almukhtar university, Libya

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ABSTRACT:

Background: Students in the faculty of dentistry are at high risk from microbial cross-contamination and accidental sharp injuries while they are treating dental patients, & therefore must be protected. Cross-contamination control is an essential aspect of the dental practice & the dental team have no doubt about its importance. The sharp instruments such as local anesthetic needles should be used very carefully to avoid occupational injuries which can lead to infection transmission. The dental students must receive vaccination particularly HBV vaccine to reduce the hazard of sharp injuries. The aim of the current survey was to evaluate awareness, and compliance of cross-contamination control guidelines among 3rd and 4th year dental students at the dental college, Omer-Almukhtar university, Libya. **Materials and Methods:** 76 members of 3th & 4th year clinical dental students have participated in this survey. Design of a questionnaire was made with 69 closed-ended questions regarding the patient screening, personal hygiene, hand hygiene, personal protective barrier techniques, immunization (vaccination status), needle stick injury, clinical waste regulations, & infection control practices & awareness. The questionnaire was distributed among the clinical dental students. Coding of all the distributed questionnaires was done for the confidentiality of responses. SPSS program was used to analyze the gathered data. **Results:** The designed questionnaire has been given to the dental students (n=76) at the University of Omer-Almukhtar, about 72 clinical dental students responded (response rate 94.7%). About 98.6% of the participants stated that they are taking medical history of their patients. The rate of protective barriers compliance among the participating dental students was very high with the exception of protective eye glasses & face shields. In the present study, male & female participating dental students showed no significant difference in their attitude toward treating patients with infectious disease. **Conclusions:** In the current survey, dental students showed excellent awareness of the cross-contamination control measures, but there was moderate compliance regarding the recommendations of cross-contamination control measures, & therefore the attitude of the dental students must be improved for the cross-contamination guidelines.

Keywords: *cross-contamination control, dental students, disinfection, sterilization, knowledge, Aljabal-Alakhdar, Libya.*

INTRODUCTION:

As the dental team are at high risk of exposure to cross contamination with viral infections, it is very important that they possess adequate knowledge & awareness of cross-contamination transmission & control guidelines. Students during their clinical training in the dental colleges are at high risk of exposure to pathogenic microorganisms.

The dental colleges are responsible for giving accurate contamination control guidelines to their students for their protection & the patients as well from getting

infections during dental treatment procedures. Infection control classes in the dental college at Omer-Almukhtar university begin as early as the 2nd year & continue throughout their study. The following strategy should be implemented to get decontamination: 1) Screening of all the patients. 2) Maintenance of health for all the dental team by hand-washing & hand-care, personal hygiene, & immunization. 3) Use of personal protective barriers by wearing masks, gloves, & eye glasses or facial shields. 4) practise proper asepsis, limiting the spread of contaminated saliva and blood by : i) Careful use of

sharp items. ii) Limiting surface contact by the concept of unit dose, disinfection of surfaces, covers, & operatory cleaning. iii) Minimizing aerosols & splatter by using: a) pre-operative mouth washes. B) high-volume aspiration. C) rubber dam isolation. D) ventilation & air filtration. iv) use of disposable items whenever possible. 5) Organize instruments carefully. 6) Disinfect or sterilize instruments & items used during patient treatment. 7) Dispose of contaminated waste safely. 8) Careful dental laboratory asepsis. 9) Provide a written infection control programme. Training of dental students by dental education can help in getting good awareness of the cross-contamination control guidelines. The aim of this survey was to evaluate awareness of the recommended cross-contamination control procedures among clinical fixed prosthodontic students at the dental college.

MATERIALS AND METHODS:

At the faculty of Dentistry, Omer-Almukhtar University in Albida city, this survey has been conducted (the year of 2023). A well-designed questionnaire was distributed among 3rd- and 4th-year clinical dental students. 69 close-ended questions (response as ‘yes’ or ‘no’) comprising the questionnaire was used to collect data regarding several aspects of microbial cross-contamination control knowledge and practices.. It was distributed to all clinical dental students. The questionnaire was filled in the college clinic without any discussion among the participants in 30 minutes & then collected immediately. The feedback was then gathered from dental students & was analyzed to achieve the objectives of the study. The tabulation & analysis of the collected was then performed.

Fig. 1: Questionnaire for assessment of knowledge of microbial cross-contamination control during fixed prosthodontic procedures.

S.n	Variables	Yes	No
		Yes	No
1	Do you take complete medical history prior to treating patient ?	Yes	No
2	Do you perform a thorough examination of the oral soft tissues before starting any fixed prosthodontic treatment procedure ?	Yes	No
3	Do you wear disposable gloves during fixed prosthodontic diagnosis & treatment ?	Yes	No
4	Do you wear disposable face mask	Yes	No

	while examining & treating fixed prosthodontic patient ?		
5	Do you wear new mask & gloves for each patients or when torn ?	Yes	No
6	Do you wear protective eyewear & face shields while treating fixed prosthodontic patients ?	Yes	No
7	Do you wear clinic coat or gown while treating fixed prosthodontic patients?	Yes	No
8	Do you use disposable blood/saliva impermeable barriers(e.g. plastic wrap) to cover the light handle & controls, chair switches, evacuator control, air-water syringe, saliva ejector, bracket table, soap dispenser, & other areas at the operator discretion ?	Yes	No
9	Do you change the surface covers between patients ?	Yes	No
10	Do you clean & disinfect the dental unit between patients ?	Yes	No
11	Do you use the spray-wipe-spray technique while disinfecting the dental unit ?	Yes	No
12	Do you clean & heat sterilize the contaminated re-usable instruments before use in treating another patient ?	Yes	No
13	Do you clean, sterilize, & store the used stock metal impression tray until needed ?	Yes	No
14	Do you clean & sterilize instruments (e.g. diamond burs, mouth mirror, excavator etc) following use ?	Yes	No
15	Do you clean & heat-sterilize handpieces in an autoclave after treatment of each patient ?	Yes	No
16	Do you disinfect custom impression trays before inserting them in the patient mouth ?	Yes	No
17	Do you discard the plastic impression trays returned from the dental laboratory ?	Yes	No
18	Do you rinse the impression to remove saliva, blood, & debris and then chemically disinfect it before sending them to dental laboratory ?	Yes	No
19	Do you rinse the impression before &	Yes	No

	after disinfection ?		
20	Do you clean & disinfect the existing fixed dental prostheses before adjusting them ?	Yes	No
21	Do you disinfect prostheses prior to sending to the lab, following checking in the oral cavity ?	Yes	No
22	Do you label all items disinfected in your clinic before sending them to the dental laboratory stating that such items have been decontaminated.?	Yes	No
23	Do you disinfect prostheses received from the lab before checking them intra-orally ?	Yes	No
24	Do you clean & disinfect the existing FDPs again following adjustment before delivering them to the patient ?	Yes	No
25	Do you clean & chemical disinfect the dental impressions before sending them to dental laboratory ?	Yes	No
26	Do you keep your hair clear away from the face during the fixed prosthodontic treatment ?	Yes	No
27	Do you remove the jewelry from hands, arms, or facial area during fixed prosthodontic treatment ?	Yes	No
28	Do you keep your finger nails clean & short ?	Yes	No
29	Do you wash your hands with anti-microbial cleaner ?	Yes	No
30	do you use liquid soap rather than bar soap for hand washing ?	Yes	No
31	Do you advise your patient to rinse with a disinfectant solution& wear protective eyewear before the commencement of the fixed prosthodontic treatment ?	Yes	No
32	Do you disinfect the bite registration records ?	Yes	No
33	Does your clinic is well-ventilated ?	Yes	No
34	Do you remove unnecessary items from the fixed prosthodontic procedure area ?	Yes	No
35	Do you preplan the materials needed during fixed prosthodontic treatment?	Yes	No
36	Do you follow the "unit-dose concept" to accomplish any dental treatment	Yes	No

	procedure prior to patient contact ?		
37	Do you utilize disposable items whenever possible ?	Yes	No
38	Do you re-use the anaesthetic needles & cartridges, saliva ejector tips, mouth wash cups, or the patient protective bib ?	Yes	No
39	Do you use pre-arranged tray set-ups for routine or frequently performed fixed prosthodontic treatment procedures ?	Yes	No
40	Do you determine the items that may become contaminated during fixed prosthodontic procedures?	Yes	No
41	Does your clinic is divided into operating "clean" area & sterilization" contaminated" area ?	Yes	No
42	Do you wrap (bag) the instrument that will not be used immediately after heat sterilization ?	Yes	No
43	Do you dispose all medical waste products properly ?	Yes	No
44	Do you dispose of the used needles & other sharps in a suitable puncture-resistant container which is labelled or colour-coded ?	Yes	No
45	Do you wear rubber utility gloves while cleaning instruments or handling clinical wastes ?	Yes	No
46	Do you report sharp injuries to the member of the dental team who is responsible for follow-up ?	Yes	No
47	Do you have any objection to treat patients with infectious diseases ?	Yes	No
48	Do you have an appropriate protocol for emergency treatment of occupational sharp injuries ?	Yes	No
49	When you have to leave a patient during a fixed prosthodontic treatment procedure e.g. to answer the telephone or to carry out an examination on another patient, Do you wear vinyle gloves over latex gloves, & remove it on returning to the patient ?	Yes	No
50	Do you replace the face mask or gown	Yes	No

	if it becomes wet while treating a patient ?		
51	Do you change the saliva ejector tip for each patient ?	Yes	No
52	Have you ever been hepatitis B vaccinated ?	Yes	No
53	Have you completed the minimum required dosage (three doses) of the hepatitis B vaccine needed to obtain adequate immunity ?	Yes	No
54	Did you have a booster dose of hepatitis B ?	Yes	No
53	Do you change the gloves after each patient ?	Yes	No
54	Do you change the face mask after each patient ?	Yes	No
55	Do you change the used handpiece for each patient ?	Yes	No
56	Do you flush the handpiece, ultrasonic scaler, & air-water syringe before re-use (between patients) ?	Yes	No
57	Do you use the autoclave for sterilization of handpieces ?	Yes	No
58	Do you change burs for each patient ?	Yes	No
59	Do you sterilize the handpieces & other dental equipments before sending them for repair ?	Yes	No
60	Do you clean & sterilize the ultrasonic scaler after each use ?	Yes	No
61	Do you use plastic wrappings for sterilized instruments ?	Yes	No
62	Do you heat-sterilize the removable light curing tip & disinfect or cover the handle ?	Yes	No
63	Do you over-load the sterilization (autoclave) tray with instruments before heat-sterilization in the autoclave ?	Yes	No
64	Do you use rubber dam for isolation ?	Yes	No
65	Do you perform pre-cleaning disinfection, using "holding" solutions for the used & contaminated fixed prosthodontic instruments ?	Yes	No
66	Do you perform pre-sterilization cleaning for the used fixed prosthodontic instruments ?	Yes	No
67	Do you clean & disinfect the work surfaces between clinical sessions ?	Yes	No

68	Do you use high-volume aspiration for fluid control ?	Yes	No
69	Do you agree that care & washing of the hands is the most effective procedure to avoid cross-contamination to the dental team ?	Yes	No

RESULTS:

The distribution of the questionnaire was done to 76 (3rd and 4th year) dental students, but 72 of them responded (response rate = 94.7%). The age & gender division of the participants was as shown in table 1.

It is important to screen all patients. This includes a full medical history, and a soft-tissue examination. In our study, 98.6% of the participants stated that they are recording the medical history before starting any fixed prosthodontic procedure. All of the participating dental students (100%) reported that perform examination of the oral soft tissue before starting any dental treatment procedure. The uses of personal protective barriers stated by clinical dental students were as shown in Table 2. Almost all the participating dental students (100%) are wearing gloves, masks, wearing new gloves & mask for each patient, cleaning & heat-sterilization of re-usable instruments, removing the jewelry from hands, arms, or facial area during fixed prosthodontic treatment, keeping the finger nails clean & short, using the rubber dam for isolation in restorative dental treatment procedures, and wrapping the instrument that will not be used immediately after heat sterilization. All of the participants reported that they are wearing gloves and masks during patient treatment. Only 93% of the dental students always used protective eyewear. Almost all of the students wear gown (98.6%) while treating fixed prosthodontic patients. When face masks & gowns were visibly contaminated (if they become wet) while treating a patient 97.2% mentioned they change their masks & gowns, all the dental students (100%) changed their gloves after each dental treatment procedure. 97.2% of dental students always wash the hands before and after gloving the hands. Most of the respondents (93%) agreed that care & washing of the hands is the most effective infection preventive procedure. In this study 98.6% of the dental students were using liquid soap for hand washing rather bar soap. The majority of the participants have received hepatitis B vaccination (86.1%). 93% of them reported that they have no objection to treat patients with infectious disease. Approximately (79.2%) of the dental students stated that they have an appropriate protocol for emergency treatment of occupational sharp injuries. 98.6% of the dental students

use puncture-resistant containers for sharp items. All of the participating students (100%) used plastic wrappings for sterilized instruments.

Out of 72 participating dental students, only 68 (94.4%) of them sterilized their handpieces by autoclaving, while the other 5.6% used chemical disinfectant. About 98.6% disposed of contaminated needles and sharp items in special puncture-resistant containers. Hand pieces sterilization is done by 94.4% of the dental students in an autoclave after treatment of each patient. Surface disinfection for wiping of the dental unit & other equipment between patients was reported by almost all of the participants (98.6%) using spray-wipe-spray technique. Furthermore, 95.8% of the clinical dental students disinfected impressions. The majority of the dental students stated that they are using autoclave (heat) sterilization for the contaminated fixed prosthodontic items. The majority of the participating dental students changed handpieces (94.4%) and burs (98.6%) between patients and 97.2% of them changed saliva ejectors between patients. All of the respondents (100%) reported that they are cleaning & heat-sterilizing the contaminated re-usable instruments before use in treating another patient. Routine disinfection of impressions was undertaken by 95.8% of the respondents. The majority of the respondents (95.8%) stated that they are cleaning & disinfecting existing dental prostheses before adjusting them, 94.5% disinfected prostheses before sending them to the lab following checking in the oral cavity, 88.8% disinfected prostheses returned from a dental laboratory before insertion into the patient mouth, and 98.6% cleaned & disinfected the existing FDPs again following adjustment before delivering them to the patient. Finally, 100% of the study sample used a rubber dam for isolation during dental restorative treatment procedures.

Table 1. Demographic characteristics of participating clinical dental students(N = 72).

Demographics		
	N %	
Gender	Male	16 (22.3%)
	Female	56 (77.7%)
Age	22-24 years .	

Table 2: Questionnaire responses for knowledge & practice of microbial cross-contamination control during fixed prosthodontic procedures.

S.n	Variables	Yes N (%)	No N (%)
1	Do you take complete medical history prior to treating patient ?	71 (98.6%)	1 (1.4%)
2	Do you perform a thorough examination of the oral soft tissues before starting any fixed prosthodontic treatment procedure ?	72 (100%)	0 (0%)
3	Do you wear disposable gloves during fixed prosthodontic diagnosis & treatment ?	72 (100%)	0 (0%)
4	Do you wear disposable face mask while examining & treating fixed prosthodontic patient ?	72 (100%)	0 (0%)
5	Do you wear new mask & gloves for each patients or when torn ?	72 (100%)	0 (0%)
6	Do you wear protective eyewear & face shields while treating fixed prosthodontic patients ?	67 (93%)	5 (7%)
7	Do you wear clinic coat or gown while treating fixed prosthodontic patients?	71 (98.6%)	1 (1.4%)
8	Do you use disposable blood/saliva impermeable barriers(e.g. plastic wrap) to cover the light handle & controls, chair switches, evacuator control, air-water syringe, saliva ejector, bracket table, soap dispenser, & other areas at the operator discretion ?	72 (100%)	0 (0%)
9	Do you change the surface covers between patients ?	70 (97.2%)	2 (2.8%)
10	Do you clean & disinfect the dental unit between patients ?	71 (98.6%)	1 (1.4%)
11	Do you use the spray-wipe-spray technique while	71 (98.6%)	1 (1.4%)

	disinfecting the dental unit ?		
12	Do you clean & heat sterilize the contaminated re-usable instruments before use in treating another patient ?	72 (100%)	0 (0%)
13	Do you clean, sterilize, & store the used stock metal impression tray until needed ?	72 (100%)	0 (0%)
14	Do you clean & sterilize instruments (e.g. diamond burs, mouth mirror, excavator etc) following use ?	72 (100%)	0 (0%)
15	Do you clean & heat-sterilize handpieces in an autoclave after treatment of each patient ?	67 (93%)	5 (7%)
16	Do you disinfect custom impression trays before inserting them in the patient mouth ?	64 (88.8%)	8 (11.2%)
17	Do you discard the plastic impression trays returned from the dental laboratory ?	64 (88.9%)	8 (11.1%)
18	Do you rinse the impression to remove saliva, blood, & debris and then chemically disinfect it before sending them to dental laboratory ?	69 (95.8%)	3 (4.2%)
19	Do you rinse the impression before & after disinfection ?	68 (94.5%)	4 (5.5%)
20	Do you clean & disinfect the existing fixed dental prostheses before adjusting them ?	69 (95.8%)	3 (4.2%)
21	Do you disinfect prostheses prior to sending to the lab, following checking in the oral cavity ?	68 (94.5%)	4 (5.5%)
22	Do you label all items disinfected in your clinic before sending them to the dental laboratory stating that such items have been decontaminated ?	70 (97.3%)	2 (2.7%)
23	Do you disinfect prostheses received from the lab before checking them intra-orally ?	64 (88.8%)	8 (11.2%)

24	Do you clean & disinfect the existing FDPs again following adjustment before delivering them to the patient ?	71 (98.6%)	1 (1.4%)
25	Do you clean & chemical disinfect the dental impressions before sending them to dental laboratory ?	69 (95.8%)	3 (4.2%)
26	Do you disinfect the large, non-sterilizable items used in the operatory, such as impression material dispensing guns, articulators, face bows, bite registration records etc. ?	71 (98.6%)	1 (1.4%)
27	Do you keep your hair clear away from the face during the fixed prosthodontic treatment ?	71 (98.6%)	1 (1.4%)
28	Do you remove the jewelry from hands, arms, or facial area during fixed prosthodontic treatment ?	72 (100%)	0 (0%)
28	Do you keep your finger nails clean & short ?	72 (100%)	0 (0%)
29	Do you wash your hands with anti-microbial cleaner ?	70 (97.2%)	2 (2.8%)
30	do you use liquid soap rather than bar soap for hand washing ?	71 (98.6%)	1 (1.4%)
31	Do you advise your patient to rinse with a disinfectant solution& wear protective eyewear before the commencement of the fixed prosthodontic treatment ?	66 (91.6%)	6 (8.4%)
32	Does your clinic is well-ventilated ?	72 (100%)	0 (0%)
33	Do you remove unnecessary items from the fixed prosthodontic procedure area ?	71 (98.6%)	1 (1.4%)
34	Do you preplan the materials needed during fixed prosthodontic treatment?	71 (98.6%)	1 (1.4%)
35	Do you follow the "unit-dose	64	8

	concept" to accomplish any dental treatment procedure prior to patient contact ?	(88.9%)	(11.1%)
36	Do you use pre-arranged tray set-ups for routine or frequently performed fixed prosthodontic treatment procedures ?	70 (97.2%)	2 (2.8%)
37	Do you utilize disposable items whenever possible ?	70 (97.2%)	2 (2.8%)
38	Do you re-use the anaesthetic needles & cartridges, saliva ejector tips, mouth wash cups, or the patient protective bib ?	0 (0%)	72 (100%)
40	Do you determine the items that may become contaminated during fixed prosthodontic procedures?	68 (94.4%)	4 (5.6%)
41	Does your clinic is divided into operating "clean" area & sterilization "contaminated" area ?	64 (88.8%)	8 (11.2%)
42	Do you wrap (bag) the instrument that will not be used immediately after heat sterilization ?	72 (100%)	0 (0%)
43	Do you dispose all medical waste products properly ?	71 (98.6)	1 (1.4%)
44	Do you dispose of the used needles & other sharps in a suitable puncture-resistant container which is labelled or colour-coded ?	70 (97.3%)	2 (2.7%)
45	Do you wear rubber utility gloves while cleaning instruments or handling clinical wastes ?	71 (98.6%)	1 (1.4)
46	Do you report sharp injuries to the member of the dental team who is responsible for follow-up ?	68 (94.5%)	4 (5.5%)
47	Do you have any objection to treat patients with infectious diseases ?	67 (93%)	5 (7%)
48	Do you have an appropriate protocol for emergency	62 (86.1%)	10 (13.9%)

	treatment of occupational sharp injuries ?		
49	When you have to leave a patient during a fixed prosthodontic treatment procedure e.g. to answer the telephone or to carry out an examination on another patient, Do you wear vinyl gloves over latex gloves, & remove it on returning to the patient ?	67 (93%)	5 (7%)
50	Do you replace the face mask or gown if it becomes wet while treating a patient ?	70 (97.2%)	2 (2.8%)
51	Do you change the saliva ejector tip for each patient ?	70 (97.2%)	2 (2.8%)
52	Have you ever been hepatitis B vaccinated ?	62 (86.1%)	10 (13.9%)
53	Have you completed the minimum required dosage (three doses) of the hepatitis B vaccine needed to obtain adequate immunity ?	51 (70.8%)	21 (29.2%)
53	Did you have a booster dose of hepatitis B ?	20 (27.7%)	52 (72.3%)
53	Do you change the gloves after each patient ?	72 (100%)	0 (0%)
54	Do you change the face mask after each patient ?	70 (97.2%)	2 (2.8%)
55	Do you change the used handpiece for each patient ?	68 (94.4%)	4 (5.6%)
56	Do you flush the handpiece, ultrasonic scaler, & air-water syringe before re-use (between patients) ?	69 (95.9%)	3 (4.1%)
57	Do you use the autoclave for sterilization of handpieces ?	68 (94.4%)	4 (5.6%)
58	Do you change burs for each patient ?	71 (98.6%)	1 (1.4%)
59	Do you sterilize the handpieces & other dental equipments before sending them for repair ?	72 (100%)	0 (0%)
60	Do you clean & sterilize the ultrasonic scaler after each use ?	72 (100%)	0 (0%)
61	Do you use plastic wrappings	72	0 (0%)

	for sterilized instruments ?	(100%)	
62	Do you heat-sterilize the removable light curing tip & disinfect or cover the handle ?	56 (77.7%)	16 (22.3%)
63	Do you over-load the sterilization (autoclave) tray with instruments before heat-sterilization in the autoclave ?	8 (11.1%)	64 (88.9%)
64	Do you use rubber dam for isolation ?	72 (100%)	0 (0%)
65	Do you perform pre-cleaning disinfection, using "holding" solutions for the used & contaminated fixed prosthodontic instruments ?	71 (98.7%)	1 (1.3%)
66	Do you perform pre-sterilization cleaning for the used fixed prosthodontic instruments ?	72 (100%)	0 (0%)
67	Do you clean & disinfect the work surfaces between clinical sessions ?	72 (100%)	0 (0%)
68	Do you use high-volume aspiration for fluid control ?	67 (93%)	5 (7%)
69	Do you agree that care & washing of the hands is the most effective procedure to avoid cross-contamination to the dental team ?	67 (93%)	5 (7%)

DISCUSSION:

Infection control procedures must be taken in health care settings to prevent the spread of disease. Because of the close contact of the dental students with patient mouth and exposure to aerosols & splashes of contaminated sharp items that might potentially contain a high number of pathogenic micro-organisms such as bacteria and viruses, they are at a high risk of getting infectious diseases. For prevention of cross-contamination among the dental team & patients, all the members of the dental team must adhere to all protocols of the infection control.

When the high speed handpieces are used, the dental team members may sustain microtrauma to the eyes, face, & hands. Such micro-lesions may serve as portals of entry for pathogenic micro-organisms contained in blood & saliva splashes generated during dental

treatment procedures. The risks involved are moderate, but precautions should be taken using several protective measures "protective eye wear & face mask" and infection control protocols to protect dental team from cross-infection. [9]

Patient screening (identifying high risk patients):

It is important to screen all patients. This includes a full medical history and a soft-tissue examination. Screening identifies some unknown carriers of infectious diseases which allows modification of cross-contamination measures in the medically compromised persons. Recording medical history before starting any fixed prosthodontic treatment procedure helps in discovering of infectious diseases. A history of infectious diseases such as acquired immunodeficiency syndrome & hepatitis must be recognized so that protection can be provided for other patients as well as office personnel. In the current survey, 99% of the participating dental students recorded the medical history before starting any fixed prosthodontic procedure.

A thorough examination of the oral soft tissues may reveal oral manifestations of HIV infection, which may identify a previously unknown carrier of the disease. The oral signs & symptoms of HIV infection are often the first recognizable features of the disease. In our study, all the participating dental students (100%) reported that they performed examination of the oral soft tissues for their patients before initiation of any fixed prosthodontic treatment procedures.

Personal protective equipment:

To avoid contact with the patients' blood or saliva contaminated with blood, the personal protective equipment (PPE) should be worn by the dental team while treating dental patients. PPE (face masks, gloves, face shields, protective eyewear and protective clothing such as gowns) act as a barrier, protecting the mucous membrane & skin of the dental healthcare workers. Wearing the PPE demonstrates to patients that the dental healthcare workers are taking precautions to implement cross-infection control measures. All the dental students (100%) reported that they wear new pair of gloves for each patient. In our study 98.6% worn thick, rubber utility gloves when cleaning instruments & handling clinical wastes. All the respondents (100%) showed regular wearing of gloves & changing them after each patient. 97% of the participants are wearing and changing face masks between patients. In contrast, less participants wore face shields and protective eye glasses (93%). Gowns should be worn by all the members of

dental team because they act as a barrier to avoid transmission of infection among the dental healthcare workers & the patients. 98.6% of the participating dental students used gown during fixed prosthodontic treatment procedures. In our study, 97.2% of the participating dental students changed the masks & gowns when become contaminated.

Personal hygiene:

The following guidelines of personal hygiene should be applied to all clinical dental team during dental treatment procedures: (1) Hair should be short or kept away from the face. Facial hair is covered by a face mask or shield (the compliance to this protocol was 98.6%). (2) Jewelry should not be worn on the hands, arms, or facial area during fixed prosthodontic treatment procedures. (3) Fingernails must be kept clean & short. The compliance to these infection control protocols was 100%. (4) Hand washing The dental practitioners must wash their hands before and after any fixed prosthodontic procedure.

In the present study, it has been found that among the responding dental students, only 93% of respondents recognized the importance of washing of hands to avoid the spread of microbial cross-contaminations to the dental team. 97.2% washed their hands with anti-microbial cleaner. In this study 98.6% of the dental students used liquid soap for hand washing. Bar soap should be avoided because it can cause spread of microbial cross-contamination. About 91.6% of the sample advised their patients to rinse with a disinfectant solution & wear protective eyewear before the commencement of the fixed prosthodontic treatment.

Precautions to avoid injuries with sharp items:

They should be used very carefully to avoid accidental injuries because they are potentially infective. If an accidental injury occurs, then it should be treated by washing the injury with soap & water to allow the wound to bleed. Eye exposure should be flooded with plain water. The injury should be reported to the member of the dental team who is responsible for follow-up. The risk from exposure to infected blood should be evaluated. If a risk is identified, laboratory tests & vaccination with immunoglobulin & hepatitis B vaccine may be necessary. In the present study 94.5% sharp instrumentl injuries were reported. Bloodborne pathogenic micro-organisms especially HBV & HIV can be transmitted by nob-sterile occupational injuries. 13.9% of the participating dental students had no knowledge of the proper treatment of the occupational injuries.

Vaccination against HBV:

All the members of dental team must receive vaccination for hepatitis B virus because they are at a high risk of getting hepatitis B infection. This can help in the protection of dental team & their family. The following should be vaccinated: 1) dentists. 2) dental hygienists. 3) dental surgery assistant. 4) dental laboratory technicians. 5) engineers who repair dental equipment. After a period of time, the number of antibodies against a particular antigen may decrease. A booster is an additional dose of vaccine administered to increase the number of antibodies. Dental team are at high risk of acquiring hepatitis B through contact with their patients. The American dental association, Centers for disease control, British dental association, & the majority of dental association throughout the world strongly recommend that dental healthcare providers are vaccinated against hepatitis B. On enquiring about whether they have received vaccination against HBV, 86.1% of dental students said that they have received it. The immunization against HBV is very important for infection control and personal protection. Among the vaccinated students in our study only 70.8% of the participants completed the minimum required dosage (three doses) needed to obtain adequate immunity. The duration of the immunity is not precisely known, but is in the order of 3-5 years. A booster dose should be given after this period, since after 5 years only 75% of individuals have adequate antibody levels.[23] In the current study, only 27.7% of the dental students have a booster dose of hepatitis B.

Sterilization and disinfection of patient-care items (surface & equipment asepsis):

It is impossible to sterilize all dental instruments, items, surfaces etc. that become contaminated during fixed prosthodontic treatment procedures. The choice of decontamination regimes is based on the instrument used. Patient-care instruments are generally categorized into critical, semi-critical or non-critical instruments. Critical dental instruments are used to penetrate tissue or to touch bone, they must be heat-sterilized, taking care not to overload the sterilization tray, as free circulation of steam is essential, only 11.1% of the participants overloaded the sterilization (autoclave) tray with instruments before heat-sterilization in the autoclave. Sterilization pouches are very useful for the sterilization & aseptic storage of single instruments, or small sets of instruments which are infrequently used, e.g. metal gauge & crown remover. Self-seal clear-view pouches are available. All the participating dental students

(100%) reported that they wrap the dental instruments that to be stored. Semi-critical instruments are used to touch mucous membranes without tissue penetration, they are heat-sterilized or disinfected. About 93% of the respondents cleaned & heat-sterilized handpieces in an autoclave after treatment of each patient. Non-critical instruments are equipments & surfaces which contact intact skin (e.g. mixing spatula & rubber bowl), they are decontaminated by disinfection.

Sterilization of the dental instruments:

Critical & semi-critical items & instruments are sterilized, if possible, by heat. There are four distinct stages which achieve safe instrument sterilization: 1) Pre-cleaning disinfection, using "holding" solutions. 2) Pre-sterilization cleaning. 3) sterilization. 4) Aseptic storage.

The sterilization area: The area for cleaning & sterilization needs careful planning, with a generous amount of room allowed for wide workshops, a sink, an ultrasonic cleaner, & sterilizer(s). The sterilization area should be situated away from the operating area. The layout of the sterilization area is illustrated in the following figure:

Dirty area	sink	cleaning area	ultrasonic bath
packing area	sterilizer	clean area	
Area of high contamination	Area of medium contamination	Area of low contamination	

Approximately 88.8% of the respondents stated that their clean divided into clean & contaminated areas.

Pre-sterilization disinfection:

After use, place the contaminated fixed prosthodontic items inside a disinfectant detergent solution to prevent blood drying on the used items, which facilitate cleaning. A synthetic phenolic solution, diluted 1:32, is an ideal holding solution. Almost all of the participating dental students performed pre-cleaning disinfection, using "holding" solutions for the used & contaminated fixed prosthodontic instruments.

Pre-sterilization cleaning:

The contaminated dental instruments should be cleaned before sterilization as the proteinaceous material protects micro-organisms on their surface from heat. The used instruments are cleaned by hand scrubbing, ultrasonic cleaning, or dishwasher. Heavy rubber utility gloves, protective eyewear, a face mask, & a plastic apron

should be worn when decontaminating dental instruments in the sterilization area. Fortunately, all the dental students in this study performed pre-sterilization cleaning for the used fixed prosthodontic instruments.

British dental association (BDA) guidelines state that handpieces must be sterilized by heat-sterilization after each patient treatment. Before re-use, handpieces & water line tubing must be effectively flushed to remove contaminated water. Flushing the air-water lines between dental patients for 20 seconds, then fitting a sterile turbine handpiece, sterile ultrasonic scaler tip, or sterile air-water syringe tip reduces the discharge of contaminated water from air lines. It has been recommended that air-water lines, which have stood unused overnight, should be flushed for 2 minutes before re-use.[19] In our survey 95.9% of the participating dental students flushed the handpiece, ultrasonic scaler, & air-water syringe before re-use to treat another patient. All the participants used sterilized kits of hand instruments and dental burs for each patient and 94.4% changed the handpieces after each patient. Nearly, 94.4% reported heat-sterilizing the handpiece after each fixed prosthodontic treatment procedure. 97.2% of respondents changed saliva ejectors between patients. About 77.7% of the respondents heat-sterilized the removable light curing tip & disinfect or cover the handle.

Ultrasonic scaler, & especially its tips, becomes very contaminated during use. Clean & sterilize the ultrasonic scaler after each use. If it is not possible to sterilize the ultrasonic scaler, the tip must be detached, cleaned, & sterilized after each use. The handle of the scaler should be thoroughly disinfected. All the responding dental students (100%) cleaned & heat-sterilized the ultrasonic scaler in an autoclave after each use.

The dentist has an obligation to decontaminated any equipment which is to be repaired or serviced by an engineer. Handpieces which are sent for repair must be sterilized if possible. In our survey, all the participating dental students (100%) stated that they sterilized the handpieces & other dental equipments before sending them for repair.

Transmission of microbial cross-contamination to the lab staff, all the items that have been inserted in the oral cavity should be decontaminated before sending them to the lab. In the present investigation, 95.8% of the respondents rinsed the impression and then chemically disinfect it before sending them to dental laboratory. However, about 88.8% of them stated that they perform disinfection for the fabricated restorations before placing them in the oral cavity of the patients. Almost all the

participating dental students (98.6%) disinfected the large, non-sterilizable items used in the fixed prosthodontic clinic, such as impression material dispensing guns, articulators, face bows, & bite registration records.

Limiting the spread of blood to surfaces:

During dental treatment & cleaning procedures, blood can be spread by anything that has been in the oral cavity. Blood may be spread around the operating zone either by contaminated gloved hands, or by splashes & splatter &, possibly, aerosols.

Limiting surface contamination by good operating technique:

It is necessary to remove unnecessary items & unused or seldom used equipment from the operating area, leaving only necessary items on worktops. This reduces the number of items which could become contaminated, consequently making post-treatment clean-up easier. Almost all the respondents (98.6%) removed unnecessary items from the fixed prosthodontic procedure area. Items & instruments which will be required for the dental treatment of each patient should be planned ahead, & anticipated. Instruments & materials which are over-looked are usually those obtained from packages in drawers or cupboards. During the dental treatment procedure, this spreads pathogenic micro-organisms to surfaces that should remain clean & that are difficult to disinfect. Plan carefully & put out instruments, materials, & medication that will be required for each dental procedure. Preparation is very important. Think ahead & place everything required for the dental treatment procedure in pre-determined positions. In our study, 98.6% of the respondents preplanned the materials needed during fixed prosthodontic treatment, while 97.2% of them used pre-arranged tray set-ups for routine or frequently performed fixed prosthodontic treatment procedures. An empty, solid-based "waste" tray should be placed near the dental practitioner, in which the used, contaminated materials are placed during the dental treatment procedures. This prevents the spread of contamination from these instruments to wider areas around the operating zone. In this survey, 88.9% of the participating dental students followed the "unit-dose concept" to accomplish any dental treatment procedure prior to patient contact.

Covering or disinfecting environmental surfaces:

There is evidence that, following dental treatment procedures, dental clinic environmental surfaces are

contaminated & pathogenic micro-organisms may survive on these surfaces for long periods of time. The surfaces in the treatment area should be either covered, or left uncovered & disinfected after dental treatment to prevent infection transmission. The light handles, hand-operated chair controls, suction hoses, chairs, & bracket tables are time-consuming & difficult to disinfect adequately. A disposable, water-proof covering e.g. clear plastic wrap can be used for this purpose. After each dental treatment: 1) Remove the soiled covering while still gloved. 2) Remove gloves & wash hands. 3) Recover the surface with clean material before the next dental procedure. This option may be expensive but has been found to be less time-consuming than surface disinfection. In this study, all the respondents (100%) used disposable blood/saliva impermeable barriers(e.g. plastic wrap) to cover the light handle & controls, chair switches, evacuator control, air-water syringe, saliva ejector, bracket table, soap dispenser, & other areas at the operator discretion, but 97.2% of them changed the surface covers between patients. **Surface disinfection:** Environmental surfaces may become contaminated during any fixed prosthodontic treatment procedure. If these surfaces were not covered, they must be cleaned & disinfected after each fixed prosthodontic treatment procedure. When disinfecting the dental clinic surfaces, wear rubber utility gloves, a face mask, protective eyewear, & a waterproof apron. Surfaces must be cleaned before they are disinfected. Spray the surface with disinfectant & wipe thoroughly with a strong gauze sponge. The sponge should be renewed frequently if heavily soiled. Re-spray & leave the disinfectant on the surface for the recommended contact time. Wipe off the residual disinfectant using a fresh paper towel. In this current study, 98.6% of the respondents reported that they used the spray-wipe-spray technique while disinfecting the dental unit & the other operatory surfaces.

Limiting contaminated aerosols & splatter:

During fixed prosthodontic treatment procedures & the clean-up period, aerosols, splatter of blood, & blood-contaminated saliva may be limited by: 1) pre-operative tooth brushing & the use of a pre-operative mouthwash "to reduce the concentration of pathogenic bacteria in dental aerosols". 2) high-velocity aspiration. 3) the use of rubber dam, when possible. 4) efficient air filtration & ventilation.

Instruct the patient to brush the teeth shortly before attending for dental treatment. Provide a 0.2% chlorhexidine mouthwash which is used by the patient

for 2 minutes immediately before dental treatment begins. These precautions reduce the concentration of the bacteria in dental aerosols. About 91.6% you advised their patients to rinse with a disinfectant solution & wear protective eyewear before the commencement of the fixed prosthodontic treatment. It has been found that when high-velocity aspiration is correctly used with the turbine handpiece, air-water syringe, or ultrasonic scaler, contamination from aerosols is reduced. This study shows that approximately 93% of the participants used high volume evacuators. A rubber dam should be used whenever possible during dental treatment procedures. It has been shown that there is a significant reduction of pathogenic micro-organisms generated in aerosols & splatter, if a rubber dam is used with the turbine handpiece, air-water syringe, or the ultrasonic scaler. Fortunately, all the respondents (100%) used rubber dam for isolation while performing dental restorative procedures.

Disposables:

In an ideal world, everything within reason that is used in dental clinical practice should be disposable. Dental supply companies advertise a vast range of disposable products, some of which would prove very expensive over a period of time to the dentist. There are certain items used in the dental clinical practice which it is suggested may be disposable. A few are listed: 1) Anaesthetic needles & cartridges: It is mandatory that these items are never re-used as they cannot be satisfactorily sterilized. 2) Mouthwash cups: They become very contaminated & plastic disposable cups are available at a low cost. 3) Saliva ejector tips: These are difficult to clean & sterilize & low-cost disposable tips should be used. 4) The patient protective bib: It becomes splattered with blood & debris during dental treatment procedures & difficult to clean & disinfect. Disposable bibs are available. 5) Disposable impression trays: They are now widely used in prosthodontics. If metal trays are used, they should be thoroughly cleaned & heat-sterilized (autoclaved) before they are re-used. 6) Prophylactic polishing cups & brushes: They are highly contaminated after use. Brushes & prophylactic polishing cups cannot be effectively decontaminated & sterilized without damage & should be regarded as disposable. About 88.9% of the participants discarded the plastic impression trays returned from the lab. 97.2% of the dental students changed the saliva ejector tip for each patient. All the participants (100%) did not re-use the anaesthetic needles & cartridges, saliva ejector tips, mouth wash cups, or the patient protective bib.

Disposal of clinical waste materials & sharps

Disposable sharp objects:

contaminated local anaesthetic needles & cartridges, & other sharp items should be disposed into puncture-resistant container & later incinerated.

Contaminated solid medical waste:

such as blood contaminated gauze, cotton rolls, gown, patient bibs, face masks, gloves, should be carefully placed into a waste receiver containing a strong bin liner. Waste should not remain in the waste receiver overnight. These wastes are sealed & discarded in plastic bags & later incinerated.

Liquid waste:

Liquid waste includes bulk blood & suctioned or waste-trap fluids. Small quantities of these liquids may be poured into a drain. All liquid wastes & contaminated medical wastes should be disposed of according to national & local environmental regulations. In this study 98.6% of the participants utilized the puncture-resistant containers for the disposal of sharp instruments.

CONCLUSION:

The findings of the present survey reveal adequate knowledge & awareness of the participating dental students toward infection control in the field of fixed prosthodontics. Nevertheless, further education is needed to improve some infection control measures including vaccination against Hepatitis B virus, wearing eye glasses, gowns and face shields, etc. All the vaccinations, especially Hepatitis B vaccination, should be set as mandatory for students prior to admission to any dental college.

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REFERENCES:

1. Milward MR, Cooper PR. Competency assessment for infection control in the undergraduate dental curriculum. *Eur J Dent Educ.* 2007;11:148–54. [[PMC free article](#)] [[PubMed](#)] [[Google Scholar](#)]
2. 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. [[Google Scholar](#)]

3. Shah R, Collins JM, Hodge TM, Laing ER. A national study of cross infection control: ‘Are we clean enough?’ *Br Dent J.* 2009;207:267–

74. [[PubMed](#)] [[Google Scholar](#)]

4. Merchant VA. Herpes viruses and other microorganisms of concern in dentistry. *Dent Clin North Am.* 1991;35:283–98. [[PubMed](#)] [[Google Scholar](#)]

5. 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. [[PMC free article](#)] [[PubMed](#)] [[Google Scholar](#)]

6. 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. [[PubMed](#)] [[Google Scholar](#)]

7. Kohn WG, Collins AS, Cleveland JL, Harte JA, Eklund KJ, Malvitz DM, et al. Guidelines for infection control in dental health-care settings - 2003. *MMWR Recomm Rep.* 2003;52:1–61. [[PubMed](#)] [[Google Scholar](#)]

8. 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. [[PubMed](#)] [[Google Scholar](#)]

9. King TB, Muzzin KB. A national survey of dental hygienists’ infection control attitudes and practices. *J Dent Hyg.* 2005;79:8. [[PubMed](#)] [[Google Scholar](#)]

10. de Souza RA, Namen FM, Galan J, Jr, Vieira C, Sedano HO. Infection control measures among senior dental students in Rio de Janeiro state, Brazil. *J Public Health Dent.* 2006;66:282–4. [[PubMed](#)] [[Google Scholar](#)]

11. Singh A, Purohit BM, Bhambal A, Saxena S, Singh A, Gupta A. Knowledge, attitudes, and practice regarding infection control measures among dental students in Central India. *J Dent Educ.* 2011;75:421–7. [[PubMed](#)] [[Google Scholar](#)]

12. 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. [[Google Scholar](#)]

13. Bentley CD, Burkhart NW, Crawford JJ. Evaluating spatter and aerosol contamination during dental procedures. *J Am Dent Assoc.* 1994;125:579–84. [[PubMed](#)] [[Google Scholar](#)]

14. Leivers M, Tangri E, Kanji NN, Hirji SK, Hernandez G, Kaminska BD, et al. Uniform contamination in the dental environment. *Can J Dent Hyg.* 2012;46:50–7. [[Google Scholar](#)]

15. 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. [[PMC free article](#)] [[PubMed](#)] [[Google Scholar](#)]

16. Hersey JC, Martin LS. Use of infection control guidelines by workers in healthcare facilities to prevent occupational transmission of HBV and HIV: Results from a national survey. *Infect Control Hosp Epidemiol.* 1994;15:243–52. [[PubMed](#)] [[Google Scholar](#)]

17. 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;65:436–48. [[PubMed](#)] [[Google Scholar](#)]

18. Peter R. Wood. Cross infection control in dentistry: a practical illustrated guide. 1992 Wolfe publishing Ltd.

19. Leivers M, Tangri E, Kanji NN, Hirji SK, Hernandez G, Kaminska BD, et al. Uniform contamination in the dental environment. *Can J Dent Hyg.* 2012;46:50–7.

20. 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.

21. Bentley CD, Burkhart NW, Crawford JJ. Evaluating spatter and aerosol contamination during dental procedures. *J Am Dent Assoc.* 1994;125:579–84.

22. 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.

23. scully, C. Hepatitis B immunisation of dental students in 14 UK dental schools. *Br. Dent. J.*, 1989; 166: 360.