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Evaluation of Infection Control in Dental Clinics: Microbial Isolation

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Abstract: There are many sources of infection in the dental clinics but the major source is the blood and saliva of the patients. The occupational potential for disease transmission is high since most human microbial pathogens have been isolated from oral secretions. The aim of this study was evaluation of infection control and microbial isolation in Ajman University of Science and Technology (AUSTN) dental clinics. A total of 385 swabs were taken from 7 clinics; 55 from each clinic. Samples taken from 8 different surfaces in each unit in the morning and afternoon. In addition from clinics door handle, floor of the clinics, X-ray machine in morning and afternoon and clinic's door handle after disinfection with Isorapid™ disinfectant solution in the afternoon to assess the presence of *Staphylococcus aureus*, *E. coli* and fungi in the dental clinics. The statistical studies of the collected data by t-test with $p<0.05$ showed no significant difference between morning and afternoon observations. Researchers conclude infection control guidelines in majority followed properly from morning to afternoon. Infection control neglected for certain surfaces such as water tap, back of Dr.'s chair, lever of Dr.'s chair and handpiece adaptors since they had surprisingly high count of *Staphylococcus aureus* and total bacterial count in certain clinics. The floor of the clinics was highly contaminated with both pathogenic and non pathogenic bacteria. Also researchers concluded that the surface disinfectants of the clinics (Isorapid™ solution) are efficient in eliminating the bacterial growth.

Key words: Bacteria, infection control, contamination, dental clinic, growth, diseases

INTRODUCTION

Infection control is one of the most important principles of dental sciences. Dental staff, surfaces and instruments are environmental factors which are regarded as principle means of disseminating microbial infections (Taheri *et al*., 2011).

Investigations has shown that infective hazards are present in dentistry because many infections can be transmitted through direct contact with blood, oral fluids or other secretions via indirect contact with contaminated instruments, equipment or environmental surfaces or by contact with airborne contaminants present in either droplet splatter or aerosols of oral and respiratory fluids (Monarca *et al*., 2000; Podgorska *et al*., 2009).

The potential for transmission of disease and cross contamination at the chair side is evident, however any item contaminated by a patient's saliva or blood is a potential source of cross contamination and transmission of disease (Monarca *et al*., 2000).

Bacterial contamination plays a main role in evaluation of infective risks for patients and dental personnel (Taheri *et al*., 2010; Szymańska and Dutkiewicz, 2008). It is well known that air, surfaces, dental materials and instruments and water in dental units could be vehicles for cross contamination with various microorganisms (Monarca *et al*., 2000).

Through this type of health care practice, many infectious agents, virus (Hepatitis B , C virus, Human Immunodeficiency virus, Herpes Simplex virus, Epstein Barr virus) and bacteria (*Streptococcus pneumoniae*, *Mycobacterium tuberculosis*, *Klebsiella pneumoniae*, *Escherichia coli*, *Legionella pneumophila* and *Pseudomonas aeruginosa*) and fungi may be transmitted (Monarca *et al*., 2002).

Method of infection control and universal precautions in the dental unit is effective in preventing cross contamination and is strongly supported by organisations such as the Centers for Disease Control and Prevention, the American Dental Association, Schools of Dentistry and many other health agencies and professional associations (CDC, 1993).

In order to minimize the risk linked to dental practice, Centers for Diseases Control and Prevention (CDC) and

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the American Dental Association (ADA) proposed various cut-offs for bacterial count in dental unit (CDC, 1993; ADA, 1996).

The aim of this study was evaluation of microbial contamination of the, surfaces and materials and comparison of total bacterial growth in the morning to the afternoon in Ajman University of Science and Technology (AUSTN).

MATERIALS AND METHODS

This descriptive research was done to compare the total bacterial count and the presence of *Staphylococcus aureus* and *E. coli* and fungi of morning (after infection control done in the previous day) to the afternoon (before infection control) in dental units of 7 clinics in Ajman University of Science and Technology (AUSTN) University. From each clinic with 15 units, 3 units have been chosen randomly.

This was accomplished by taking swabs from 8 different areas in each unit (Water tap, low volume suction tip, high volume suction tip, light switch, back of Dr.'s chair, lever of Dr.'s chair, high speed handpiece adaptor, low speed handpiece adaptor) as well as clinic's floor, X-ray machine, door handle. A total of 385 swabs were taken, 55 from each clinic. Cultured was done on a duplicate plate (plate for bacterial count agar), a Violet Red Bile Agar (VRBA) (coli form agar) and then a bird parker agar (*Staphylococcus aureus* agar). Then, researchers incubated the VRBA on 35°C for 24 h and the plate count agar and bird parker agar for 48 h in the incubator. Then, researchers counted colonies on colony counter. To confirm the presence of *E. coli* a confirmation test was carried out were we transfer the typical colony from the VRBA using a loop to the Brilliant Green Lactose Bile (BGLB) broth and incubate the broth at 35°C incubator for 24 h; the positive result can be identified by noticing a gas in the Durham tube. Statistical analysis done using paired sample t-test with $p<0.05$.

RESULTS AND DISCUSSION

Results of total bacterial count and presence of *Staphylococcus aureus*, fungi in morning and afternoon is shown in Fig. 1-3. For the *E. coli* results, it was negative for all the surfaces.

Fungi results where negative for the floor of the clinics, clinic's door handle and X-ray machine. The statistical studies of the collected data by t-test with $p<0.05$ showed no significant difference between morning and afternoon observations. The total bacterial count and total count of *Staphylococcus aureus* and fungi in the morning in most of the results shown equal or slightly higher than the afternoon and in variety of collected data was shown 0 for both morning and afternoon. Statistical results for total bacterial count, *Staphylococcus aurous* and fungi are shown in Table 1-3.

Efforts to prevent and control the spread of infections vary within dental health facilities or those involving provision of dental care. The present study

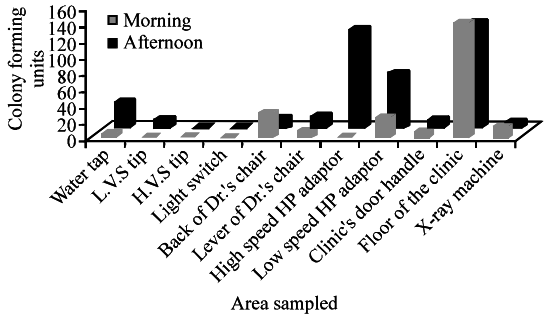

Fig. 1: Comparison of morning and afternoon for total bacterial count results of area sampled

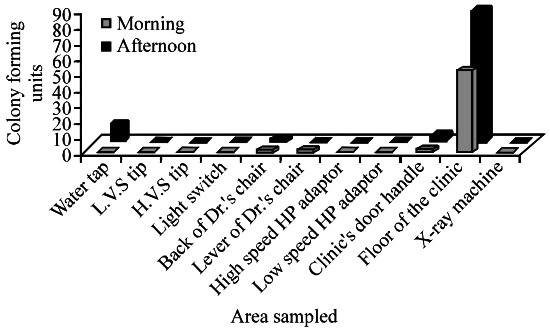

Fig. 2: Comparison of morning and afternoon for *Staphylococcus aureus* of area sampled

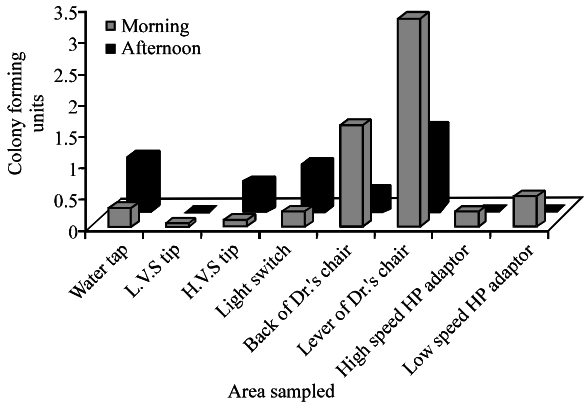

Fig. 3: Comparison of morning and afternoon for fungi count results of area sampled

Table 1: Statistical results of paired t-test with p<0.05 for total bacterial count results of water tap, L.V.S tip, H.V.S tip, light switch, back of Dr.'s chair, lever of Dr.'s chair, high and low speed handpiece adaptors

Sites	Time	Mean	Mean difference	SD	SE	t-values	p-value (two-tailed)
Water tap	Morning	5.81	-25.048	98.641	21.525	-1.16	0.2583
	Afternoon	30.86					
L.V.S tip	Morning	1.57	-8.524	28.190	6.152	-1.39	0.1811
	Afternoon	10.10					
H.V.S tip	Morning	1.90	0.714	4.787	1.045	0.68	0.5019
	Afternoon	1.19					
Light switch	Morning	0.67	-1.381	3.840	0.838	-1.65	0.1150
	Afternoon	2.05					
Back of	Morning	31.38	20.429	97.813	21.345	0.96	0.3500
Dr.'s chair	Afternoon	10.95					
Lever of	Morning	10.00	-3.905	27.333	5.965	-0.65	0.5201
Dr.'s chair	Afternoon	13.90					
High speed	Morning	2.00	-120.350	513.294	114.776	-1.05	0.3075
Hp adaptor	Afternoon	120.43					
Low speed	Morning	25.38	-39.619	256.719	56.021	-0.71	0.4876
Hp adaptor	Afternoon	65.00					

Table 2: Statistical results of paired t-test with p<0.05 for *Staphylococcus aureus* results of water tap, L.V.S tip, H.V.S tip, light switch, back of Dr.'s chair, lever of Dr.'s chair, high and low speed handpiece adaptors

Sites	Time	Mean	Mean difference	SD	SE	t-values	p-value (two-tailed)
Water tap	Morning	0.667	10.570	34.810	7.597	-1.39	0.1793
	Afternoon	11.230					
L.V.S tip	Morning	0.095	0.048	0.384	0.084	0.57	0.5764
	Afternoon	0.048					
H.V.S tip	Morning	0.524	0.524	2.182	0.476	1.10	0.2844
	Afternoon	0.000					
Light switch	Morning	0.238	0.190	0.680	0.148	1.28	0.2137
	Afternoon	0.048					
Back of	Morning	1.714	0.190	10.210	2.228	-0.09	0.9327
Dr.'s chair	Afternoon	1.905					
Lever of	Morning	1.333	0.190	6.439	1.405	0.14	0.8935
Dr.'s chair	Afternoon	1.143					
High speed	Morning	0.381	0.381	1.161	0.253	1.50	0.1483
Hp adaptor	Afternoon	0.000					
Low speed	Morning	0.952	0.952	4.364	0.952	1.00	0.3293
Hp adaptor	Afternoon	0.000					

Table 3: Statistical results of paired t-test with p<0.05 for fungi results of water tap, L.V.S tip, H.V.S tip, light switch, back of Dr.'s chair, lever of Dr.'s chair, high and low speed handpiece adaptors

Sites	Time	Mean	Mean difference	SD	SE	t-values	p-value (two-tailed)
Water tap	Morning	0.286	0.571	2.357	0.514	-1.11	0.2798
	Afternoon	0.857					
L.V.S tip	Morning	0.048	0.048	0.218	0.048	1.00	0.3293
	Afternoon	0.000					
H.V.S tip	Morning	0.095	0.476	2.247	0.490	-0.78	0.4462
	Afternoon	0.476					
Light switch	Morning	0.238	0.761	2.786	0.608	-0.86	0.3991
	Afternoon	0.762					
Back of	Morning	1.619	1.286	4.606	1.005	1.28	0.2155
Dr.'s chair	Afternoon	0.333					
Lever of	Morning	3.286	1.952	5.766	1.258	1.55	0.1364
Dr.'s chair	Afternoon	1.333					
High speed	Morning	0.238	0.238	0.700	0.153	1.56	0.1349
Hp adaptor	Afternoon	0.000					
Low speed	Morning	0.476	0.476	2.182	0.476	1.00	0.3293
Hp adaptor	Afternoon	0.000					

compared the total bacterial count (CFU mL^{-1}), presence and total count of *Staohylococcus aureus*, fungi and *E. coli* in morning (after infection control done in previous day) to the afternoon (before infection control) of 7 dental clinics in Austn dental clinics to evaluate their efforts in following infection control guidelines.

There was no significant difference between morning and afternoon observations and the total bacterial count and total count of *Staphylococcus aureus* and fungi in the morning in most of the results shown equal or slightly higher than the afternoon and in variety of collected data shown 0 for both morning and afternoon which means

infection control guidelines in majority followed properly from morning to afternoon and the barriers where effective in reducing the bacterial growth.

Staphylococcus aureus and total bacterial count were very high in certain surfaces, water tap, back of the Dr.'s chair, lever of Dr.'s chair and handpiece adaptors since these surfaces mostly touched without barriers and this indicate infection control neglecting. The floors of the clinics were highly contaminated with both pathogenic and non pathogenic bacteria. Also, researchers concluded that the surface disinfectants of the clinics (Isorapid™ solution) are efficient in eliminating the bacterial growth since we saw 0 bacterial growth after application of disinfectant.

Data on microbial contamination of surfaces or instruments in dental surgeries are different. Some research has shown extensive contamination of surfaces (O'Donnell *et al*., 2005; Rautemaa *et al*., 2006; Decraene *et al*., 2008).

Monarca *et al*. (2002) in evaluation of environmental bacterial contamination and procedures to control cross infection in a sample of Italian dental surgeries concluded that the contamination of air was fairly high; a-haemolytic Streptococci, Staphylococci and fungi were often found producing extensive microbial contamination in the environment. Air contamination was also responsible for surface contamination by bacteria. Data on dental unit water samples showed high levels of microbial contamination. Bacterial counts were much higher than both the American Dental Association target for the quality of dental unit water and the EU drinking water guidelines (Monarca *et al*., 2000)

Castidlia showed high microbial accumulation in surfaces was registered at the beginning of work activities and increased during the day. About >50% of samples showed values above the threshold in control of environmental microbial contamination in public dental surgeries they concluded that this was probably due to inadequate disinfection at the end of work activities. The 87 university dental units were tested for *P. aeruginosa* and *Legionella* sp. Specimens were collected by mixing together equal volume of water from all water points of each dental unit. No samples exceeded the CDC 2003 threshold value of 500 CFU mL^{-1}. Total and fecal coliforms were not found in 87 dental unit water samples the prevalence of *P. aeruginosa* was 13.8% while the prevalence of *Legionella* sp. was 33.3%. Only one sample (1.1%) was positive both for *P. aeruginosa* and *Legionella* sp., while 47 (54.0%) were negative for both microorganism (Monarca *et al*., 2002).

In this research, the unit surfaces that showed higher level bacterial growth were water tap, back of Dr.'s chair, lever of the Dr.'s chair, high speed handpiece adaptor, lowspeed handpiece adaptor where mostly uncovered and touched by contaminated gloves of the dentists in certain surfaces we saw very high level of total bacterial count and *Sataphylococcus aureus* such as total bacterial count 450 and 64 CFU mL^{-1} on water tap of clinic F (F1 and F2) in afternoon versus 0 and 5 CFU mL^{-1} in the morning, 2300, 50,70 and 80 (CFU mL^{-1}) on highspeed handpiece adaptor of clinic D (D2), clinic E (E1, E2) and clinic F (F3) in afternoon versus 0 in the morning.

Fungi were found in higher amount on back and lever of Dr.'s chair. About 20 CFU mL^{-1} fungi were on back of Dr.'s chair of clinic A (A1) in the morning versus 0 CFU mL^{-1} in the afternoon. And 30 CFU mL^{-1} fungi were on lever of Dr.'s chair of clinic A (A1) in the morning versus 10 CFU mL^{-1} in the afternoon.

High level of bacteria both total bacterial count and *Staphylococcus aureus* was seen on floor of the clinics. In all of the clinics except clinic D the total bacterial counts in the morning where higher than the afternoon. In certain clinic, some increase was seen in total bacterial count on door handle of clinics in the afternoon than the morning. For the X-ray machine the total bacterial count counted 40 CFU mL^{-1} in clinics A and F in the morning versus 10 and 3 in the afternoon were higher than the other clinics. Fungi results where negative for the floor of the clinics, clinic's door handle and X-ray machine.

The clinics door handle, after taking the afternoon samples where disinfected with Isorapid™ solution (a non-aldehyde disinfectant solution), according to instructions written on the disinfectant, researchers swabbed the surface after 1 min and the results of total bacterial count, *Staphylococcus aureus*, fungi and *E. coli* were negative.

Williams (2006) published a research surface contamination in the dental operatory, researchers obtained samples from surfaces in clinic operatories including the light handle covers, jacket cuffs, sinks and floors in the morning and afternoon. Their analysis showed that some surfaces were significantly more contaminated in the afternoon than in the morning in 11 area of obtaining samples. Areas with significant differences were light handle, right jacket cuff, left jacket cuff and floor and sink side (Williams, 2006).

Motta *et al*. (2007) done a research to determine the number of *Staphylococcus aureus* isolates collected in a dental clinical environment and to determine their susceptibility to antimicrobial agents commonly used in Dentistry University of Campinas, Brazil.

Sterile cotton swabs were used to collect the samples from dental-chair push buttons, light handles, 3 in 1 syringes, computer enter keys, doorknobs and X-ray tubes before, during and after clinical procedures. Sampling was performed before (at 5:30 a.m.), during (between 2:00 and 3:00 p.m.) and 1 h after (at 6:30 p.m.) clinical procedures. An increase in the number of

Staphylococcus aureus was observed during clinical procedures ($p<0.05$). The dental-chair push buttons were the most contaminated ($p<0.05$) (Motta *et al*., 2007).

Barlean *et al*. (2010) evaluated dental practice airborne microbial contamination during clinical activity in order to evaluate the risk of infection for the patients and dental staff. A total of 90 air samples were collected at the beginning of the working day and after 4 h of clinical activity. The bacteriological indicators that were used were Total Number of Mesophilic Germs (TNMG; CFU m^{-3}), *Staphylococcus aureus* (CFU m^{-3}) and fungi (CFU m^{-3}). The bacteriological results were correlated with the treatment procedures (Barlean *et al*., 2010).

The mean value for the TNMG in the air was 129 CFU m^{-3} at the beginning of the day and 429.6 CFU m^{-3} after 4 h of clinical activity. The mean value of TNMG was twice as high in dental practices in which ultrasonic scaling was performed. For fungi counts, the values were twice as high after clinical activity. Coagulase-positive Staphylococcus was isolated in 6 (6.6%) of all air samples. They concluded that there is higher air contamination after dental treatments as compared to levels for the beginning of the working day (Barlean *et al*., 2010).

CONCLUSION

Researchers conclude that barriers were effective in reducing the growth of bacteria from morning to afternoon. Control guidelines in majority followed properly from morning to afternoon. But still the student groups that are working in the previous day 4:30-8:30 p.m. are not following infection control guidelines properly. Certain surfaces such as water tap, back of Dr.'s chair, lever of Dr.'s chair and handpiece adaptors had surprisingly high count of *Staphylococcus aureus* and total bacterial count in certain clinics since these surfaces mostly touched without barriers and this indicate infection control neglecting. The floor of the clinics was highly contaminated with both pathogenic and non pathogenic bacteria. Also, researchers concluded that the surface disinfectants of the clinics (Isorapid™ solution) are efficient in eliminating the bacterial growth.

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