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Full Length Research Paper

Screening of microbial contamination of radiographic films in order to avoid cross infection in maxillofacial surgery clinics

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Radiographic investigation in maxillofacial surgery is a vital procedure in minor as well as major surgical procedures in dentistry and in this Department, for example, both analog and digital radiography is used. Patient files are usually transferred from one clinic to another according to the patient appointments and most dentists and surgeons routinely handle these files before treating patients. Since radiographic films are not subjected to disinfection a variety of bacteria may be transferred from the oral cavity to these films and then to other patients via process of cross infection. Although most dental clinics are currently moving to digital technology even the use of this approach may lead to cross contamination, since the sensors and phosphor plates used in digital radiographs are also not generally autoclavable. The aim of the work described in this study was therefore to screen radiographic films used at the Maxillofacial Surgery clinics in the College of Dentistry, King Saud University for contamination with potentially pathogenic bacteria and fungi. A total of 447 radiographs films including periapical, occlusal and orthopantomograms (OPG) from patients treated at the clinics of Oral and Maxillofacial Surgery, College of Dentistry, King Saud University were collected in sterile plastic bags and screened for bacterial contamination. All films were swabbed using sterile swab sticks and bacteria were then identified using standard laboratory procedures. After identification of the contaminant bacteria, data were analyzed using SPSS software. The qualitative assessment of the tested samples showed that all tested radiographic films samples were contaminated with bacteria. Staphylococci (*Staphylococcus aureus* 33.8% and coagulase negative *Staphylococcus epidermidis* 18.1%) were the most frequently isolated bacteria, although species of *Streptococcus* (3.6%) and *Bacillus* (3.6%) were also isolated; only 23.5% of the tested films were contaminated with fungi, mainly *Aspergillus niger.* This study demonstrates that radiographic films can be a source of cross infection in dental clinics and since these films are not subjected to any disinfection there is a need for the application of strict hygiene measures during their handling in order to avoid cross infection of microorganisms from these films.

Key words: Radiographs, cross infection, maxillofacial.

INTRODUCTION

The radiographic investigation in maxillofacial surgery is a vital procedure both in minor as well as major surgical procedures. Both analog and digital radiography systems are used in our Oral and Maxillofacial Surgery Department. Patient files are usually transferred from one clinic to another to meet the requirements of patient appointments during which they are handled by dentists and surgeons. These radiographic films which are originally

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Table 1. Percentage of radiographic films contaminated by bacteria.

Bacteria	Frequency	Percent
S. aureus	151	33.8
E. coli	159	35.6
Bacillus spp	40	8.9
Streptococcus spp	16	3.6
S. epidermidis	81	18.1
Total	447	100.0

Table 2. Percentage of radiographic films contaminated by fungi.

Fungi	Frequency	Percent
no fungi	342	76.5
Aspergillus niger	105	23.5
Total	447	100.0

sterile before use are not subjected to disinfection pro-tocols in the clinics. The films are usually considered safe to be handled. As a result, a variety of bacteria may be transferred from the oral cavity of one patient to another following the accidental contamination of these files, thereby leading to cross contamination (Kohn et al., 2003). More than five hundred species of microorganisms belonging to around 30 different genera have been identi-fied in the oral cavity (Bowden and Hamilton, 1998). Cross infection by these organisms may take place through objects such as files, pens and radiographic films, most of which are never sterilized. The epidemiology, degree of cross infection and associated costs which occur in dental clinics remains to be determined (Fox, 2010). Although most of the clinics are currently moving to digital technology, the use of such advanced technology is not secure from cross infection contamination (MacDonald and Waterfield, 2011) As the components used to pro-duce digital radiographs, such as sensors and phosphor plates are not usually autoclavable, they may therefore be vehicles of microbial cross contamination. Both Gram-positive and Gram negative bacteria can survive under a variety of environmental conditions (Noskin et al., 1995). Such organisms can survive for many hours to weeks on nonporous surfaces (Reynolds et al., 2005) from where they can be infectious at very low doses. Infectious bac-teria and other microorganisms can be transmitted from the hands of operators to radiographs and thence to pa-tients, a route which provides an important means of pathogen cross contamination from everyday objects, such as phones (Ulger et al., 2009). Despite advances in technology and materials, cross infection is still consi-dered a risk in dentistry. Numerous articles have addres-sed infection control in the field of dentistry, and several researchers have surveyed infection-control practices and cross infection in dental clinics (Alt-Holland et al., 2012; Bajuscak et al., 1993; Decraene et al., 2008; Dreyer and Hauman, 2001; Huntley and Campbell, 1998; Kahn et al., 1982; Legnani et al., 1994) but no studies have investigated the contamination of radiographic films in the oral and maxillofacial surgery clinics where more strict cross infection prevention protocols are applied in these clinics. With the above considerations in mind, the aim of the research reported here was to screen the radio-graphic films used at the Maxillofacial Surgery clinics in the College of Dentistry at King Saud University in order to determine whether such microbial contamination represents a potentially significant problem.

MATERIALS AND METHODS

A total of 447 radiographs films including periapical, occlusal and orthopantomograms (OPG) (related to patients treated at the clinics of Oral and Maxillofacial Surgery, College of Dentistry, King Saud University) were collected from the patients files in sterile plastic bags and screened for bacterial contamination. All films (both surfaces) were swabbed with swab sticks moistened with sterile water. Each swab was placed in 2 ml of brain heart infusion broth in a sterile falcon tubes, and vortexed for one minute. Total amount of 100 µl was plated out on nutrient agar plates. All samples were plated within two hours of collection from the radiographic films. The agar media were incubated aerobically at 37°C for 24 h. Pure colo-nies of isolates were identified and characterized using standard microbiological techniques. Results were analyzed by descriptive analysis using SPSS software.

RESULTS

The results show that all of the tested radiographic films samples were contaminated with bacteria. Staphylococci (*Staphylococcus aureus* 33.8%9 (of the samples) and coagulase negative *Staphylococcus epidermidis* 18.1%) were the most frequently isolated species, followed by species of Bacillus (8.9) and Streptococcus (3.6%) (Table 1). Of all tested films only 23.5% were contaminated with fungi, mainly *Aspergillus niger* (Table 2). Table 3 shows the number of samples contaminated with both bacteria and fungi. Of the films exhibiting Staphylococcal contamination, 38% also contained *A. niger*, while only 16% of films which were contaminated with *E. coli* were also contaminated with this fungus.

DISCUSSION

Although cross infection in dental practice is related mainly to direct exposure to patient's fluids such as blood or saliva, infections can also be transmitted through contaminated surfaces and materials (Alt-Holland et al., 2012; Guida et al., 2012; Pinheiro et al., 2012).

Radiographic - investigations are considered a vital component in diagnosis in maxillofacial surgery and hundreds of radiographs are routinely handled at clinics every day. Such radiographs are often held with or without the

Table 3. Numbers of radiographic films contaminated by both bacteria and fungi.

Bacteria	Number of contaminated films	
	Bacteria only	Bacteria + fungi
S. aureus	119	32
E. coli	133	26
Bacillus spp	16	24
Streptococcus spp	7	9
S. epidermidis	67	14
Total	342	105

use of gloves, a manipulation which introduces the risk of microorganisms from a patient's oral cavity contaminating the radiographic films and then other hospital operatives and other patients. Radiographic films are not subjected to any disinfection procedures and are routinely ignored as a potential source of cross infection. Some important potential cross infection surfaces, such as dental hand-pieces, are similarly rarely sterilized between patients and may act as a source of cross infection between patients and dental practitioners (Razak and Lind, 1995).

In the study reported here, bacterial contamination of radiographic films used in the maxillofacial clinics, College of Dentistry, King Saud University was investiga-ted. All tested surfaces of the radiographic films were found to be contaminated with bacteria mainly *S. aureus*. This bacterium is regarded as one of the most versatile and harmful human pathogen and it can be transferred from radiographic equipment to patients and medical operatives (White and Glaze, 1978). It has also been shown that *S. aureus* is the main contaminant of dental pediatric clinics and represents a major risk factor in cross infection (Negrini et al., 2009). In another study,*S. aureus* was shown to be a major contaminant of a range public and hospital surfaces (Otter and French, 2009). In the Riyadh region, sand storms are a routine part of the weather and these may be a factor in causing surface contamination in medical facilities, since dirty surface harbour more bacteria than do clean ones. *S. epidermidis* is considered to be a major nosocomial pathogen and plays an important role in many device related infections (Ziebuhr et al., 2006). The presence of *S. aureus* on the radiographic films which are manipulated without a rou-tine disinfection procedure in the clinics may increase the risk of transmission of such organism to other critical areas such as the operating filed. Unsterilized radiogra-phic films from maxillofacial surgery clinics are also shared in hospitals during major surgery and this may play a role in transferring potential pathogens to the hospital envi-ronment. Species of *Streptococcus* and *Bacillus* were also found here to contaminate radiographic films. Enterococci can survive in the dry conditions present on surfaces and can be transmitted following their touching or handling. The presence of *E. coli* on the surface of the tested radiographic films can also be a risk for cross infection during surgical procedure in case of improper manipulation of the radiographic films. The situation of cross infection becomes more problematic if the bacteria involved are antibiotic resistant strains, which can lead to serious nosocomial infection (Denis et al., 2012). Fungi are also now being considered as a cause of nosocomial infections (Groll and Walsh, 2001). In this study we found that radiographic films were contaminated with *A. niger*, and some radiographic films harbored both bacteria and fungi. The radiographic films which are originally sterile before their use become contaminated in the clinics due to their manipulation. These films are not subjected to any routine disinfection protocol and may be a persistent source of cross infection in the clinics in case of improper manipulation.

Conclusion

This, and other studies, show that radiographic films can act as a source of bacterial cross infection in dental clinics and it is recommended that, since these films are usually not subjected to any disinfection procedures, strict hygiene procedure need to be in place to prevent them from acting as a source of the cross infection of potential pathogens.

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