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Infection Control Protocols and Practices in Dental Laboratories: A Review

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ABSTRACT

Infection control and prevention is one of the most efficient and economical interventions against diseases in health care. Infectious diseases can be transmitted in dental laboratories through direct or indirect contact; hence infection control ought to be an essential aspect of dental laboratory practice to prevent dental laboratory personnel from exposure to infectious diseases. The aim of this review is to upgrade our knowledge on possible infection control protocols/practices in dental laboratories and to emphasize their importance.

Key words: Dental laboratory technicians, Disinfection, Immunization, Personal Protective Equipment (PPE)

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INTRODUCTION

The need for infection control in dental practices can never be Overemphasized. The conveyance of diseases in the dental lab is well documented. It is therefore imperative that dental technicians and technologists strictly adhere to the standard protocols to prevent potential risks of cross-contamination, by that means, producing a safe environment for patients and staff [1].

An infection has been defined as an invasion of the host organism by microorganisms, toxins, or parasites that can cause pathological conditions or diseases [2]. Cross-infection is defined as the transmission of microbial agents between patients and healthcare workers [3]; while cross-contamination is defined as the transfer of a contaminant from a source, specimen, etc., to a different or uncontaminated one [4].

Infection control is vital in dental practice. It encompasses the efforts taken to prevent and control the spread of infections within dental health facilities or those primarily involved in the provision of dental care. About 1 ml of saliva sample from the oral cavity of an average healthy person comprises an estimated 750 million microorganisms; consequently, it is one of the most debated topics in dentistry and has become a constituent of the practice that dental health workers no longer question its necessity [5].

Preventing harm to patients from care aimed at helping them (*i.e.*, patient safety) is one of the determinants which describe quality in healthcare. As stated by Vazquez-Rodriguez et al. [6], prevention of care-related contagion is reported the most common detrimental effect on care delivery and hence, is a key issue.

As dentistry is mainly a field of surgery which involves exposure to saliva/blood and other potentially infectious materials, it ultimately requires a high standard of infection control and safety in regulating cross-contamination and occupational exposures to blood and saliva borne diseases. Dental care professionals are unarguably at an increased risk of cross infections while treating patients. However, as opposed to the dental treatment rooms and surgical operatories where infection control measures are sternly recommended and enforced, the dental laboratories are often overlooked. This constitutes a threat and is hazardous to the safety of dental technicians and technologists, who may acquire pathogenic microorganisms from contaminated impressions, prostheses, and by inappropriate handling of clinical materials in the dental laboratory [7].

In as much as infection control protocols in dental laboratories differ globally, and whilst a lot of guidelines have been issued and revised periodically, hygiene in many dental laboratories unfortunately still continue to be dissatisfactory, which hints at the need for more rigid control measures. Hence, this review is aimed to upgrade our knowledge and highlight the infection control

protocols and practices in dental laboratories, to prevent cross-contamination and the spread of infectious diseases.

LITERATURE REVIEW

An extensive review of literature relating to infection control, protocols, and practices in dental laboratories from 2017 to 2022 was carried out, using Google scholar, Science direct, Medline, PubMed and, Wiley Online Library data base. Few literatures between 2013 and 2015 were also reviewed because they were found relevant. A search of literature located within the academic databases was conducted using the keywords, infection control, dental laboratory technicians, dental impressions, and dental laboratories. A total of 49 articles were identified of which 35 were included for the purposes of this review.

Infection transmission in dental laboratories

Since the dental office and the laboratory are usually not in the same physical facility and given the high potential for cross-contamination between the two settings, excellent communication between the two is vital for effective infection control [8].

Generally, infection is spread if the following conditions or criteria are available: The presence of a pathogenic micro-organism (pathogen), the presence of a susceptible host (immunocompromised), portal of entry for the pathogen (to the susceptible host), reservoir or source that allows the pathogen to survive and multiply (e.g., blood), and a mode of transmission from the source to the host [9].

In as much, exposure to micro-organisms cannot be avoided; however, exposure will not cause disease unless the five previously mentioned criteria are present. The absence of any one of these conditions will prevent the transmission of an infectious disease. Consequently, the main goal of infection control is to remove one, two, or all of these criteria [10].

Miller stated that the primary route of infection transmission from the patient to the dental technician is through contaminated impressions, prostheses, and clinical materials as a result of being in direct contact with patient's mouth, saliva, and perchance, blood [11]. On the other hand, cross infection from the dental technician to the patient(s) is a possibility. This can occur when the pumice slurry used in prostheses polishing is not properly disinfected and changed at regular intervals. The pumice has to be changed daily, and the machines must be disinfected regularly as well. This also applies to polishing paste [12].

In further clarification, Volgenant and de Soet outlined the route of infection transmission of pathogens as direct contact, indirect contact, inhalation or contact *via* oral mucosa [13]. Direct contact transmission takes place when the transfer of microorganisms occurs as a result of direct physical contact between an infected or colonized individual and a susceptible host. This can occur as a result of contact with oral secretions or blood in the patient's mouth.

Indirect contact involves the latent transfer of an infectious pathogen to a susceptible host *via* an intermediate object. This exposure occurs when in contact with instruments, materials, prostheses, and other contaminated laboratory equipment or items.

Inhalation is another possible route of transmission and involves infectious agents that are distributed through droplet nuclei (*i.e*. remnants from evaporated droplets) containing infective microorganisms. They can survive outside the body and remain suspended in the air for long periods of time. Infection occurs *via* the upper and lower respiratory tracts.

Contact of conjunctival, nasal, or oral mucosa with droplets generated from an infected person (e.g. by talking, coughing, or sneezing) can also be a possible route of infection as the actions can send infectious droplets into the air. If healthy people inhale the infectious droplets, or if the contaminated droplets land directly in their eyes, nose or mouth, they risk becoming infected [14].

Micro-organisms can remain both inside and on the surface of the impressions, and oral bacteria can stay viable for as long as one week even in set gypsum. This makes it difficult to disinfect dental casts than impressions because the microorganisms seep into the inner parts of these casts hence making disinfection difficult. A number of potentially infectious biological agents like *Mycobacterium tuberculosis*, Hepatitis B and C, Herpes simplex viruses and HIV have been documented. For instance, it has been documented that dental personnels have a 5–10 fold possibility of contracting hepatitis B infection than the general population [15,16].

Infection control practices and protocols in dental laboratories

Dental laboratories are often overlooked as regards strict infection control measures and this poses a threat to the safety of dental technicians and technologists, who are at risk of acquiring pathogenic microorganisms from contaminated impressions, prostheses, and by improper handling of clinical materials after arrival at the dental laboratory. Every dental setting (*i.e*., clinic, unit or laboratory, centre) should have an infection control program aimed to avert the transmission of disease from patient to dental team, from dental team to patient, or from patient to patient.

Infection control in dental laboratories was pioneered by American Dental Association (ADA) through its recommendations and guidelines of the Centres for Disease Control (CDC). It was first published in 1986 and then revised in 1993 [17].

In as much as contaminated items from the dental laboratory may not get to the patient, as they could be disinfected on arrival at the clinic (which is not assessed in this review), the high percentages (60%) of

contaminated items not disinfected before leaving the dental office [18], and the scarce communication between laboratories and clinics [19] make cross-contamination control practices for preventing cross-infection in the dental laboratory a matter of concern as regards quality of care and occupational hazard [20].

As it is not possible to diagnose all infected patients from their medical histories, readily available laboratory tests, or physical examinations, the Occupational Health, and Safety Administration (OSHA) has instituted guidelines known as "bloodborne pathogen standards". This implies that all human blood and saliva should be treated as if known to be infectious for Hepatitis B Virus (HBV), Human Immunodeficiency Virus (HIV), and other blood-borne pathogens [21].

Ultimately, there are fundamental practices which need to be strictly adhered to by the dental technicians and technologists to avoid infections in dental laboratories. These include special disinfecting area, use of Personal Protective Equipment (PPE), hand hygiene and immunisation.

Special disinfecting/receiving area: Basmaci, et al. stated that it is imperative to establish designated disinfecting and working areas [22]. All incoming cases should be first stored in this area, disinfected without delay, and transferred to work areas only after complete disinfection. All containers are to be sterilized or disinfected after every use. Also, packing materials should be thrashed immediately to avoid contamination. As opined by Sammy and Benjamin, there must be an infection control policy in the form of a poster, and displayed on the wall in this area. In addition, the policy must be renewed annually or when necessary, to take in new disinfection techniques and get rid of the outmoded ones. Laboratories should be trained prior to the introduction of any form of disinfection processes.

Disinfection: The Australian Dental Association (ADA) postulated that to make impressions contamination-free, they are thoroughly rinsed with cold running water to remove saliva and any traces of blood, and then diluted detergent is applied as disinfectant [23]. To bolster this, studies have shown that a small quantity (10%-15%) of micro-organisms remain on impressions 10-15 seconds after rinsing in water, so it is essential for it to undergo disinfection or sterilization methods. In as much as sterilisation is ideal, it is not applicable as the temperature and time required would destroy the impressions, most dentures, and appliances. It is recommended that all disinfection procedures should be carried out in the dental laboratory by well-trained technicians/technologists. The right disinfectant should be used so as to prevent corrosion in metallic components, and dimensional changes as well as surface textures for impressions [24,25]. According to Alzain, if an impression is not disinfected, it can cross-contaminate the entire laboratory area, creating an avenue for microorganisms to travel back and forth from the laboratory to the clinical area [26]. Furthermore, dental laboratories should set apart prostheses of high-risk patients from other laboratory work. The duration and disinfection technique depends on the absorbability of the impression material and the time lapse between impression-taking and disinfection.

Methods of disinfection

Basmaci, et al. explained that dental impression materials can be disinfected in two ways namely immersion and spray. The most effective is disinfection by immersion because it exposes all the surface area to the disinfectant whereas the spray tends to act only on the areas applied. The most commonly used disinfectants are chlorhexidine, glutaraldehyde (0.5%, 2%, 2.2% and 2.45%), Sodium Hypoclorite (NaOCl) (0.5%, 0.525%, 1%, 4% and 5.25%), hydrogen peroxide (0.5%), phenols (7%) and iodophores (5% and 10%), according to the type of impression material. Polysulphides, addition silicones and condensation silicones should be disinfected with disinfectants that do not cause dimensional changes to them. Polyethers are prone to dimensional changes when immersed for more than 10 minutes, whilst prolonged immersion time of hydrophilic impressions makes the material less hydrophilic. Impression compound is best disinfected with phenolic spray or iodophors [27,28].

Firoozeh, et al. are of the opinion that pumice slurry used in the polishing of prostheses could be a possible source of contamination to dental laboratory technicians when the wide variety of microorganisms in saliva and blood of patients are put into consideration [29]. Therefore, pumice slurry must be changed after the conclusion of every case. Also, the pumice and rag wheels must be disinfected daily.

DISCUSSION

Use of personal protective equipment: It is important that dental laboratory technicians and technologists working in the special disinfection/receiving area put on Personal Protective Equipment (PPE); clean laboratory coats, protective eyewear (goggles), face masks, and disposable gloves. These personal protective equipment must be used whenever there is potential for splashes, spatter, spray, or aerosols such as when operating model trimmers, polishing lathes, motors, or any other rotary equipment. Donning (put on) involves putting on the required apparel before patient contact and must be performed in the following order: Hand hygiene, gown, mask, eye or face protection, and gloves. When doffing (taking off), hand hygiene must be performed after taking off each item, starting with gloves, eye or face protection, gown and mask. If the proper procedure is not followed, blood, body substances and other potentially infectious material could be transferred to both healthcare workers and patients. Solid wastes soaked with bloody fluids should be put in sealed impervious bags and discarded following the regulations of the local or national environmental agencies [30,31].

Work surfaces in working areas and equipment should always be kept clean and disinfected daily. All materials, attachments and instruments which are to be used on

new prostheses should be set aside from those used on prostheses that have already been put in the mouth [32].

Hand hygiene: Personal hygiene and care of hands have been identified as the most important infection-control precautions to prevent transmission of diseases. Furthermore, hospital-based studies have shown that noncompliance with hand hygiene practices is associated with health-care-associated infections and the spread of multi-resistant organisms. Dental technicians/technologists should wash hands before and after removing gloves. The use of alcohol-based hand-sanitizers or hand rubs is also encouraged [33,34].

The proper procedure for washing hands

The proper technique for washing hands involves:

- Wetting the hands.
- Dispensing soap and then working up a lather.
- Hands should be scrubbed for at least 20 seconds.
- Making sure to wash all surfaces, including your palms, the backs of your hands, in between your fingers and under your fingernails.
- Wash off the soap with clean water.
- Dry hands thoroughly using paper towel.
- Use towel to turn off faucet.

Immunization: Hepatitis B virus (HBV) immunization is strongly recommended for health care workers, dental technicians, and technologists inclusive. This is because HBV infection is the major infectious hazard for dental health care practitioners. Transmission of HBV is chiefly when in contact or exposed to blood or body fluids of a person with either acute or chronic HBV infection. Immunization is the best option to prevent HBV infections in dental settings, dental laboratories inclusive [35].

CONCLUSIONS

Infection control is a vital aspect of health care; hence it is essential to ensure that dental laboratory staff complies with infection control protocols and guidelines to prevent cross-contaminations and spread of diseases in the lab. Although, dental laboratory personnel may be theoretically aware of infection control guidelines and protocols, there should be;

- Infection control guidelines and protocols written in clear and simple language in the lab and updated when necessary.
- Infection control signages and posters that illustrate different ways to prevent diseases (such as, wash your hands, cover your cough, etc.,) displayed on working surfaces, walls or areas mostly used in the dental laboratory.
- There should be compulsory continuing professional development courses, seminars, and trainings on infection control regularly for the dental laboratory technicians, technologists, and other laboratory staff, to update their knowledge on the latest infection control protocols. This will greatly encourage compliance to infection control protocols.
- Importantly, there should be sufficient communications between the dentist and dental laboratory technicians/ technologists on disinfection/decontamination of items that have been shipped (they must have label stating whether they were disinfected and with which disinfectant), the dental technician and technologist on the other hand should also inform the dentists of the status of every completed dental prosthesis (dental work) sent to the dental clinics.

DECLARATION OF INTEREST

The authors report no conflict of interest. The authors alone are responsible for the content of this article.

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