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Cross Infection in Prosthetic Laboratories: Means of Decontamination and Prevention

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Abstract

Background: Reducing cross-infection in dental prosthesis laboratories requires the implementation of protective measures and knowledge of disinfection protocols. We conducted a survey of dental technicians in Casablanca, with the aim of identifying and assessing infectious risks, as well as decontamination and prevention measures. **Material and Methods:** To achieve our objective, a descriptive epidemiological survey was carried out among 50 dental technicians working in the city of Casablanca, using an anonymous questionnaire. **Results:** The results of our study revealed that the use of protective means by dental technicians is low, as only 28% of dental technicians always wear gloves and masks, 26% always wear glasses and only 28% wear professional clothing (overalls), as well as 58% of dental technicians disinfect the work received and 34% of prosthetic laboratories are equipped with an autoclave. A minority of dental technicians are vaccinated against hepatitis B (14%), followed by tuberculosis (16%) and COVID-19 (24%). With regard to communication between dental laboratory technicians and dentists, our study showed that 74% of dental technicians say that dentists disinfect work before sending it out, and only 40% of dentists who notify at-risk patients. Our survey showed that 96% of the prosthetists in our study are aware of the infectious risks of the profession, and 20% attend seminars on cross-infection control. **Conclusion:** According to our research, most dental technicians employed in Casablanca's private sector do not use preventive measures against cross-infection, and are unaware of the decontamination protocol.

Subject Areas

Dentistry

Keywords

Cross-Infection, Decontamination, Dental Laboratory, Prostheses

1. Introduction

The handling of chemicals, bacteria, and pathological products of human origin in prosthetic practice poses certain infectious dangers.

In dentistry, prosthetic procedures are certainly one of the acts where the breach of aseptic technique is most common due to the close communication between the dental office and the prosthetic laboratory, which increases the risks of cross-contamination through the transmission of pathogenic microorganisms between the patient, the dentist, the assistant, and the laboratory technicians [1].

This contamination issue occurs throughout the prosthetic chain, from the impression, which nevertheless represents a major potential source of infection in prosthetics, to the prosthetic fabrication. It has been proven that over 60% of prostheses delivered to laboratories by dental clinics are contaminated with pathogenic micro-organisms from patients' oral cavities [1].

The transmissible microorganisms in the prosthetic chain are:

- Viruses: Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), Herpes Simplex Virus (HSV), Influenza Virus, Epstein-Barr Virus (EBV), and Cytomegalovirus (CMV).
- Bacteria: Staphylococci, Streptococci, *Mycobacterium tuberculosis*, Pseudomonas, Klebsiella.
- Fungi: Candida albicans.

The implementation of appropriate protection and prevention measures, along with adherence to good practice guidelines, aims to limit these risks and prevent or minimize cross-contamination. However, it is essential that these rules and measures are well-known and strictly followed, thus creating a safe environment for both patients and healthcare personnel [2].

In order to identify and assess infectious risks as well as decontamination and prevention strategies, we conducted an investigation at the city of Casablanca's prosthetic laboratories.

2. Material and Methods

To conduct a descriptive cross-sectional survey, simple random sampling was used, including 50 prosthetic laboratories over 8 prefectures in Casablanca.

The survey instrument is an anonymous individual questionnaire, designed on the basis of information gathered from the scientific literature. It consists of 20 questions, the majority of which are pre-determined to simplify completion of the document. The questionnaire has four sections:

- Identity.
- Communication with the dental practice.
- Means of protection.
- Information and knowledge.

3. Results

The study population of private-sector dental technicians practicing in the city of

Casablanca is predominantly male, 84%.

28% of the population studied had health problems, distributed as follows:

- 10% suffered from respiratory disorders.
- 6% have musculoskeletal disorders.
- 4% have ear disorders.
- 8% have other problems (Table 1).

In terms of seniority, 56% of the dental technicians in our sample have 10 or more years' experience, 26% between 5 and 10 years, and 18% less than 5 years.

Table 1. Distribution of prosthetists according to the type of disease.

	Headcount	Percentage
No health problem	36	72%
Respiratory disorders	5	10%
Musculoskeletal disorders	3	6%
Ear disorders	2	4%
Other issues	4	8%
Total	50	100%

1) Mode of receiving dental work

88% of prosthetists say that the work they receive from dentists comes with an index card. 50% of dental technicians receive work from dentists in plastic bags, 72% in plastic boxes (Table 2).

Table 2. Method of receiving work from dentists.

Method of receiving dental work	Headcount	percentage
With laboratory worksheet	44	88%
Without laboratory worksheet	6	12%
Total	50	100%
Plastic bag	14	28%
Plastic box	36	72%
Total	50	100%

2) Disinfection of dental work by the dentist

According to 74% of dental technicians, dentists disinfect their dental work before sending it out. Alcohol is used by 26% of dentists as a disinfectant (Table 3).

3) Notification of patient at risk

60% of practitioners do not notify patients at risk. However, Thirty percent of notification cases require a phone call.

4) Means of protection

94% of prosthetists have a separate reception area. 28% always wear gloves and masks when receiving dental work.

Table 3. Type of solution used by dentists for dental work disinfection.

Disinfection of dental work by the dentist	Headcount	Percentage
Alcohol	14	39%
Hypochlorite	7	19%
Tap water	2	5%
Aldehyde	2	5%
Other	12	32%
Total	37	100%

Disinfecting incoming work is made by 78% of prosthetists disinfect work received from dental practices, by immersion in a disinfectant solution in 64% of cases (Table 4).

Table 4. Disinfection of dental work by prosthetists.

Disinfection of dental work by prosthetists	Headcount	Percentage
Always	29	58%
Sometimes	10	20%
Never	11	22%
Total	50	100%
Using alcohol	17	44%
Using hypochlorite	6	16%
Using aldehyde	3	7%
Using hydrogen peroxide	3	7%
Others	10	26
Total	39	100%

5) Wearing means of protection by prosthetists

88% of prosthetists wear glasses or visors at work, 78% of prosthetists do not use noise-cancelling headphones or earplugs and 62% of prosthetists do not wear professional outfits at work (Table 5).

Table 5. Wearing means of protection.

Wearing means of protection	Yes	No	Total
glasses or visors at work	44 (88%)	6 (12%)	50 (100%)
Noise-canceling headphones or earplugs	11 (22%)	39 (78%)	50 (100%)
professional uniforms	19 (38%)	31 (62%)	50 (100%)

6) Vaccination: (Table 6)

INFORMATION AND KNOWLEDGE:

Table 6. Distribution of dental technicians according to vaccinations.

Vaccination	Headcount	Percentage
COVID-19	12	24%
Tuberculosis	8	16%
Hepatitis B	7	14%
Influenza	6	12%
Tetanus	1	2%

96% of dental technicians are aware of the infectious risks associated with the profession. However, 80% of dental technicians do not attend cross-infection control seminars and prosthetist health conferences or seminars.

4. Discussion

4.1. Characteristics of the Study Population

By gender:

The study population of private-sector dental technicians practising in the city of Casablanca is 84% male-dominated. A study of dental technicians in Galicia showed a male predominance of 68.5% [3]. Another study carried out in Jordan among dental technicians showed a male predominance of 67.5% [4].

According to the health status:

Our study showed that 28% of prosthetists have a health problem. 10% of the dental technicians had respiratory problems, and 6% had musculoskeletal problems. A study carried out in Sweden on the profile of work-related health problems among dental laboratory technicians in Sweden showed that 79% of prosthetists have health problems including 31% have respiratory problems and 68% have musculoskeletal problems [5].

According to seniority:

The majority of prosthetists in our sample have 10 or more years' experience with a percentage of 56%, followed by 26% of prosthetists who have between 5 and 10 years practice, and finally 18% of technicians have less than 5 years' practice. According to a similar study carried out in Romania on a sample of 68 prosthetists, 37.5% of prosthetists have between 3 and 5 years' experience followed by 25% who have 0 to 3 years' practice, then 21.9% who have between 5 - 10 years and finally 15.6% who have more than 10 years [6].

4.2. Communication between the Dental Laboratory and the Dental Practice

Mode of work reception:

In our sample, 88% of respondents confirm that dentists commonly send their work accompanied by a worksheet, and 72% receive work in plastic boxes.

A study carried out in India showed that 93.8% of impressions/prostheses were transported in plastic bags [7].

A similar study carried out in Bamaco on the decontamination of impressions in dental practices and laboratories showed that:

- 60% of dentists who send impressions to the laboratory with an index card.
- 47.5% of dentists who send them to the laboratory in a plastic bag [8].

We deduce that there is communication between the dentist and the prosthetics laboratory via a worksheet.

Disinfection of dental work by the dentist:

74% of the dental technicians say that dentists disinfect work before sending it out. 26% of dentists use alcohol, 14% use hypochlorite, 4% use running water and 4% use aldehyde. A study in Brittany showed that 96% of dentists disinfect all items before sending them to the laboratory [9]. According to the study conducted in Bamaco 42.5% among dentists who decontaminate work before sending it use running water, 32.5% use hypochlorite and 2.5% use aldehyde [8].

Alcohol was not cited in the literature as a disinfectant for dental work. This shows that the 26% who use this product are unaware of its benefits.

Notification of at-risk patients:

Our study indicated that 40% of dentists notify the laboratory of patients at risk.

In a survey of UK dentists, among 77 responses, 31.3% of practitioners notified the laboratory of patients at risk of infection [10]. Moroccan dentists' notification of at-risk patients is close to that of the United Kingdom.

Means of protection:

This research showed that 94% of dental technicians have a separate reception area.

A study carried out in India shows that 56.3% of dental technicians stated that their laboratory had a separate reception area [7]. 28% of the dental technicians always wore gloves and a mask when receiving work. In a study carried out in Galicia, 62.4% of prosthetists systematically used gloves when receiving items [3]. 12% of dental technicians reported routinely wearing gloves when receiving items from various dental clinics in a study conducted in Jordan. [4]

Disinfection of incoming dental work:

58% of prosthetists among a workforce of 50 prosthetists who disinfect work received from dental practices. According to a study conducted in India, 32% of laboratory technicians who disinfect work received [7].

64% of prosthetists disinfect incoming work by immersion in disinfectant solutions. According to a study conducted in India, 67.2% of prosthetists who decontaminate incoming work use the immersion method [4] [7].

This study showed that 46% of dental technicians use alcohol and 16% use hypochlorite. According to a study carried out in Brittany, the chemicals most commonly used by prosthetists for disinfection are hypochlorite, chlorhexidine and glutaraldehyde [11].

Duration of disinfection:

The investigation revealed that 52% of prosthetists disinfect work received for between 5 and 10 minutes and 28% disinfect work for between 10 and 20 minutes.

According to the study conducted in India, the average disinfection time was 10 minutes for 45.3% of prosthetists [7].

Our results are not compatible with what has been cited in the literature, since according to the latter, the decontamination time for impressions is 10 minutes [12].

Wearing means of protection during work:

The study showed that 62% of prosthetists sometimes wear glasses or visors at work and 26% always do. A survey of dental technicians in Romania found that 16% occasionally wore protective eyewear and 84% always did [13].

62% of the prosthetists in this research do not wear professional clothing. A study carried out in India showed that 4.7% did not wear an apron [7]. Recommendations from OSHA (The Occupational Safety and Health Administration of the United States of America) have suggested the use of protective clothing such as gloves, visor, apron and face mask to reduce the risk of exposure by pathogenic organisms [7].

Vaccination:

16% reported having had the vaccine, which is unreasonable given that the BCG vaccine is compulsory in Morocco from birth.

The results indicated that 14% of prosthetists are vaccinated against hepatitis B. A survey carried out in Romania showed that 38% are vaccinated against hepatitis B [13]. Another survey in India showed that 59.3% are vaccinated against hepatitis B [7]. The Hepatitis B vaccination status of Moroccan prosthetists is at the lower end of the scale than that of India and Romania. This study, which found that a significant percentage of dental technicians had not been vaccinated, suggests that vaccination against hepatitis B should also be stepped up [14].

The results revealed that 6% have periodic examinations every year to 2 years. A study in Korea showed that prosthetists had ideas about the appropriate frequency of regular check-ups was once a year 53.6% or once every six months 41.8% [15].

Our research demonstrated that 66% of prosthetic laboratories do not have an autoclave. A study carried out in Karachi (Pakistan) showed that 59.8% of prosthetic laboratories do not have an autoclave [16]. The results of our study show that prosthetists are not aware of the importance of sterilizing materials.

Information and knowledge:

The results of this research indicated that 20% of dental technicians attend seminars on cross-infection control. A study of 121 dental laboratory technicians in Saudi Arabia, 43.8% receive training courses on infection control [17]. This could mean that there were not enough seminars, and lack of time may prevent prosthetists from attending courses on cross-infection control.

To minimize the risk of cross-infection, a decontamination protocol and appropriate preventive measures must be implemented.

4.3. Work Decontamination

Decontamination of prints involves 2 stages, whatever the material: [18]

- Pre-disinfection:

Rinsing with running water to remove saliva and blood for 10 seconds [19]. Rinsing is recommended until all saliva and blood have been removed, but there is no recommended duration, as the effectiveness of the disinfectant decreases in the presence of organic debris. For example, sodium hypochlorite [20]. According to the ADF (Association Dentaire Française), running water alone eliminates nearly 90% of germs, so this step is essential but insufficient [21].

- Disinfection:

Disinfection is carried out using a disinfectant solution, as this is the most practical means of disinfection in the dental practice.

Disinfectant solutions are generally made up of a combination of aldehydes (glutaraldehydes, formaldehydes and quaternary ammoniums or halogenated derivatives "sodium hypochlorite") [22].

The choice of disinfection method must respect the preservation of the physicochemical qualities of the impression materials (distinction between hydrophilic and hydrophobic materials) and the efficacy of the disinfection method (virucidal disinfection) [5].

A disinfectant solution must meet the following criteria:

- Ease and speed of use.
- Non-toxic for the user.
- Biodegradable.
- Compatibility with materials.
- Do not alter the material or impair reproduction of details.
- Does not interfere with the setting of replica materials [22].

These disinfectant solutions are used by dipping or spraying.

Their choice and application vary according to the impression material [22] (**Table 7**).

Table 7. Choice of disinfectant type and duration of application depending on impression material according to Chidambaranathan and Balasubramanium (2017) [12].

Impression material	Disinfectant	Duration
Alginate	- Sodium hypochlorite - Iodophors	10 minutes
Polyethers	- Sodium hypochlorite - Iodophores - Phenolic complexes	10 minutes
Polysulfides	- Sodium hypochlorite - Iodophores - Phenolic complexes	10 minutes
Silicones	- Sodium hypochlorite - Iodophores	10 minutes
Zinc oxide-eugenol	- Iodophores	10 minutes

Sterilization protocols for plaster models alter their quality, and autoclaving reduces their compressive strength. On the other hand, models can be disinfected effectively, while retaining their plaster characteristics, by rapid immersion for 2 to 3 minutes in a 0.525% sodium hypochlorite solution. Oven drying for 2 hours at 45˚C also provides good disinfection and would improve the plaster's mechanical properties [21].

Occlusion models and waxes can be immersed in a 0.525% sodium hypochlorite solution or treated with an iodophor solution [21]. Resin prostheses containing no metal elements are preferably immersed for 15 minutes in a 0.525% sodium hypochlorite solution [21]. Metal bases:

Metal bases can be decontaminated with an iodophor solution or a 2% glutaraldehyde spray, according to the time recommended by the manufacturer.

All these decontamination treatments must be followed by prolonged rinsing [21].

4.4. Means of Protection

A clean uniform or smock must be worn at all times during the manufacturing process. They must be changed every day and must not be worn outside the laboratory [23].

Gloves Sterile or not, are designed for handling contaminated medical equipment and chemicals (disinfectants). They protect against cross-contamination [18]. A study has shown that nitrile gloves offer the best protection [24].

Prevents contamination of the patient and the environment (air, surfaces, equipment), protects the wearer from airborne infectious agents and protects against the risk of splashing biological fluids. It can be fitted with a visor to protect the eyes [18].

Wide-fitting goggles with a return on the ribs must be worn systematically by laboratory staff for any procedure generating splashes or aerosols. They can be replaced by visors (masks with visors or independent visors) [18].

Hearing protection must be worn during critical operations, when noise reaches harmful levels, *i.e.* 80 dB (A) (decibels) and above [24].

Dental technicians must regularly undergo specific medical examinations for the purpose of assessing their fitness for work [24].

The first-aid kit must contain specific products: calcium gluconate in injectable and drinkable solutions, or in cream in the event of an accident involving hydrofluoric acid, oxygen therapy and infusion equipment, treatment kits in the event of cyanide poisoning.

Prosthetic laboratories must be equipped with an autoclave for sterilizing materials using steam under dry heat pressure to prevent the transmission of microorganisms, including viruses, bacteria, fungi and spores [23].

A receiving area must be set up separately from the production area [23].

4.5. Recommendation

In order to avoid cross-infection, the following recommendations should be

followed: - Establish a line of communication between the dental practice and the dental laboratory concerning decontamination of work and notification of patients at risk. - Use personal protective equipment (overalls, gloves, goggles, mask, etc.) to decontaminate work and perform aseptic procedures, in order to avoid cross-contamination. - Establish a rigorous decontamination protocol for each impression material and prosthesis. - Use of an autoclave to sterilize equipment to prevent the transmission of pathogens. - Separate area for receiving prosthetic work. - Clean and disinfect work surfaces. - Post and update instructions in the event of a workplace accident. - Regular medical check-ups as part of reinforced medical surveillance. - Up-to-date vaccinations (Tetanus, Hepatitis B, Influenza, COVID-19…) [25]. - Improved working conditions through periodic checks by the labor inspector. - Introduction of formal, compulsory infection control courses and guidelines. - Development of new CAD/CAM digitizing technologies to minimize risk.

5. Conclusion

In prosthetics, there is a close link between the dentist and the dental technician, with the possibility of transferring germs from the patient to the laboratory, or vice versa. There is therefore a potential danger of contamination, which is why a comprehensive hygiene prevention plan is needed to optimize the means of combating occupational infectious risks. In our study, we found that conformity with infection control procedures was low, as the majority of dental technicians working in the private sector in Casablanca did not use preventive measures against cross-infection, even though they said they were aware of the biological risks associated with this profession. Our survey revealed a lack of communication between dental technicians and dentists, as well as a lack of knowledge of disinfection protocols for prosthetic work. The use of computer-aided design and manufacture (CAD/CAM) can help combat cross-infection.

Conflicts of Interest

The authors declare no conflicts of interest.

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