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| ORIGINAL

# *Microbial contamination in dental equipment and disinfection potential of different antimicrobial agents*

# *Contaminação microbiana em equipamentos odontológicos e potencial de desinfecção de diferentes agentes antimicrobianos*

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## ABSTRACT

**Objective**: To analyze the dental equipment microbial contamination and to test different disinfectants, collaborating with the protocols control of cross infection in dental care. **Methods**: Samples were collected from dental equipment (syringes; auxiliary table; reflector), cultured in Petri plates with Brain Heart Agar (for bacteria) and Sabourad Agar (for fungi) culture medium. After collection of the initial samples, the surfaces were randomly divided and disinfected with the following products: ethanol 70% (A70); 5% chlorhexidine (CHX5) and, glucoprotamina 0.5% (GLP0,5). New sample collections were made from the same locations described above (final samples). **Results**: No disinfectant product tested was able to eliminate all microbial forms (bacteria and fungi) surfaces. For bacteria, the antimicrobial activity was higher with the ethanol 70%, followed by 5% chlorhexidine and glucoprotamina 0.5%. For fungi, the 5% chlorhexidine had the best effect, followed by ethanol 70% and glucoprotamina 0.5%. **Conclusion**: The study confirmed the contamination of surfaces of dental equipment and the importance of disinfection for infection control in the dental clinic. Through this study, no antimicrobial agent tested was 100% effective in eliminating microorganisms present in the dental clinic surfaces.

**Indexing terms**: Chlorhexidine. Containment of Biohazards. Dental clinics. Disinfection. Ethanol.

## RESUMO

***Objetivo**: Analisar a contaminação microbiana em equipamentos odontológicos e testar diferentes agentes desinfetantes, colaborando com os protocolos de controle de infecção cruzada nos atendimentos odontológicos. **Métodos**: Foram coletadas amostras de equipamentos odontológicos (seringas tríplices; mesa auxiliar; refletor), semeadas em placas de Petri com meios de cultura ágar cérebro coração (para bactérias) e ágar Sabourad (para fungos). Após as coletas das amostras iniciais, as superfícies foram aleatoriamente divididas e desinfetadas com os seguintes produtos: álcool etílico 70% (A70); clorexidina alcoólica 5% (CHX5); e, glucoprotamina 0,5% (GLP0,5). Foram realizadas as coletas finais das amostras, dos mesmos locais descritos acima. **Resultados**: Nenhum produto*

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*desinfetante testado foi capaz de eliminar todas as formas microbianas (bactérias e fungos) das superfícies. Para bactérias, a ação antimicrobiana foi superior com o uso do álcool etílico 70%, seguido da clorexidina alcoólica 5% e da glucoprotamina 0,5%. Para fungos, a clorexidina alcoólica 5% teve o melhor efeito, seguido do álcool etílico 70% e da glucoprotamina 0,5%.* ***Conclusão****: O estudo confirmou a contaminação das superfícies dos equipamentos dentais e a importância da desinfecção para o controle de infecção na clínica odontológica. Através deste estudo, nenhum agente antimicrobiano testado foi 100% efetivo na eliminação dos microrganismos presentes nas superfícies odontológicas.*

***Termos de indexação****: Clorexidina. Contenção de riscos biológicos. Clínicas odontológicas. Desinfecção. Etanol.*

## INTRODUCTION

From the 1980s, with the Acquired Human Immunodeficiency Syndrome (AIDS) emerging, the concern of dentists with the problem of direct and cross-infection has raised, which can affect the professional, the patient and the auxiliary team. Thus, greater importance has come to be given in order to reduce the risk of transmission of contagious diseases during dental practice. For effective control of cross-infection it is necessary to adopt Universal Precaution rules [1,2]. The principle of Universal Precautions is that all blood and body fluids should be considered potentially infected with hepatitis virus type B (HBV) and type C (HCV) and human immunodeficiency virus (HIV), or other pathogens, due to the fact that the identification of these patients is not always possible, either because they do not know their situation due to the long incubation period, or because they do not want to reveal their situation to the professional. In this way, all patients should be considered as potentially transmitters of pathogens and, therefore, the Universal Precautions should be applied for infection control [2,3]. Prior to the adoption these universal rules in 1987, there were reports of HBV transmission from 14 surgeons to their patients and nine dentists who transmitted HBV to 55 patients [4].

The adoption of standard precautions makes the dentist perform his activity safely for both the patient and his team. Based on this, it is necessary that professionals have knowledge of the etiopathogenesis of infectious diseases so that they can become aware of the importance of adopting infection control protocols in order to reduce the risk of occupational diseases resulting from their activity [3,5,6]. Stopping cross-infection in dental offices represents a major challenge for dentists, researchers and microbiologists. Microorganisms are often able to overcome the safety measures adopted today, putting professionals and patients at risk. On the other hand, the lack of care of some dental surgeons in relation to biosafety has led to an intensification of the cycle of cross-infection in the dental office [7-9]. Several factors in a dental office can lead to infection, such as not disinfecting and / or incorrect sterilization of the instruments used, not washing the lab coat regularly, and inadequate cleaning of the work environment, however, it is possible to reduce the risk of cross infection when the dental surgeon correctly follows the infection control protocols [9,10].

Disinfection procedures performed in healthcare environments should promote the reduction of the level of contamination by toxic microorganisms and proteins (bacterial prions and endotoxins) in inanimate items (articles and areas). Disinfection procedures do not guarantee the elimination of all microbial forms (mainly spores and toxic proteins). Several factors can influence the effectiveness of disinfection procedures, such as the antimicrobial activity of chemical agents and the chemical and physical characteristics of the environment surrounding the one to be disinfected. Furthermore, the antimicrobial activity of the agents is directly proportional to the number of microorganisms present. Therefore, scrupulous prior cleaning is considered essential for the successful disinfection [11].

In the routine of health practices, ethyl alcohol, in concentrations between 60 to 90%, can be indicated for disinfection processes, being preferably used in concentrations of 70 to 77%. It is indicated for low-level or intermediate-level disinfection, acting on Gram-positive and Gram-negative vegetative bacteria, on mycobacteria (Mycobacterium tuberculosis) and on some fungi and viruses, but they do not have sporicidal activity [11,12]. The antimicrobial activity of alcohol is conditioned by its concentration in weight or volume in relation to water, when in the concentration of 70% (P/P) or 77% (V/V) the dehydration of the microorganism's cell wall does not occur, but yes, the penetration of the product inside, where protein denatures, a process that does not occur with alcohol in concentrations other than those mentioned [12].

Since the 1990s, studies have been carried out with a disinfecting agent known as glucoprotamine. This is a multi-component substance resulting from the reaction of compounds obtained from natural coconut oil. Glucoprotamine is non-volatile, non-teratogenic, non-mutagenic, easily degradable, dissolves easily in water and has excellent toxicological properties, is non-corrosive to metals and is compatible with most materials used in healthcare. It is active in vitro against vegetative bacteria including mycobacteria, fungi and viruses [13,14]. In the medical field, it has been used for about 15 years. According to a study [15], glucoprotamine proved to be a very effective and fast antibacterial and antifungal agent, even at low concentration (0.5%), being able to eliminate all the bacterial isolates tested in just 1 minute [15].

Chlorhexidine, a chemical that was introduced many years ago as a broad-spectrum antiseptic against Gram-positive and Gram-negative bacteria, acts on bacteria by disrupting the integrity of their cytoplasmic membranes resulting in the loss of vital cellular constituents such as nucleic acid and potassium. Although chlorhexidine kills vegetative forms of bacteria, it is not effective against spores, except at elevated temperatures. In dentistry, the alcoholic solution of chlorhexidine emerged as a disinfectant for the surgical field and root canals, but currently it has been indicated for the cleaning of prostheses, the degermation of the hands, among others. In one study [16], aqueous solutions of chlorhexidine from a concentration of 1% demonstrated greater efficacy in disinfecting surfaces when compared to aqueous solution of chlorhexidine 0.5%, alcohol 70% gel and liquid, which may indicate it for the use in the disinfection routine of clinical practice [16]. Considering the variety of products available and the different levels of microorganism control demonstrated by disinfectant agents, this study aimed to analyze microbial contamination in dental equipment and to test different disinfectant agents used in the routine of clinical practice, in order to collaborate with the protocols for cross-infection control in dental care.

## METHODS

This work was carried out in dental care clinics of an educational institution in the city of Passo Fundo-RS. The collected samples were analyzed at the Microbiology Laboratory of the Institute of Biological Sciences (IBS) of the University of Passo Fundo, RS, Brazil.

### Selection of dental equipment

Six dental equipment from four clinics with high turnover of care were drawn, totaling 24 pieces of equipment.

### Sample collection

Initial (i) and final (f) bacterial samples, (i: before any intervention; f: after the application of disinfection protocols), were collected with sterile swabs, moistened in sterile saline, and rubbed on the tip of the outer surface the triple syringes (pST), the handle of the equipment's clinical table (aMC) and the reflector handle, right side (pRD). The samples were immediately sown in Petri dishes with different culture media, in duplicates: 1- brain heart agar (BHA); 2- Sabourad agar (ASab).

After collecting the initial samples (i) (prior to the disinfection protocol), the teams were randomly divided, by lot, into three groups (two teams, per clinic, for each group) and the same surfaces were disinfected with the following products: group A70 – 70% ethyl alcohol; group CHX5 – 5% alcoholic chlorhexidine; and, GLP0.5 group – 0.5% glucoprotamine. Afterwards, the final collections of the samples (f) were carried out, from the same locations described above, and sown in the selected culture media, in duplicates.

For each test group, samples were collected from the three selected surfaces, before and after disinfection.

### Disinfection protocol

The surfaces selected for sample collection were disinfected, after random selection, with the products to be tested (A70; CHX5; GLP0.5) by rubbing with sterilized cotton soaked in the disinfectant agent, for 30 seconds.

## Cultivation of cultures

The BHA plates were incubated for 48h at 37ºC, and the ASab plates were incubated for 7 days at 25ºC, in bacteriological greenhouses.

## Analysis of results

After the incubation period, the cultures were read (counted). For bacteria, microbial growth (MG) was classified according to the number of Colony Forming Units (CFU), being: 0= none; 1= very little (≤10 CFU); 2= moderate (> 10≤50 CFU); 3= high (> 50 CFU). The presence of contamination of samples collected before and after disinfection, between groups, were compared by Fisher's exact test, at a 5% significance level. Disinfectant products were also compared in relation to their antimicrobial activity. The bacterial colonies were analyzed for their macroscopic morphology, in order to enable the identification of distinct bacterial types. For fungi, microbial growth was classified considering the presence of fungal growth (1) or the absence of fungal growth (0).

## RESULTS

Were analyzed 288 Petri dishes in this study; 144 for each microbial group (bacteria and fungi).

The frequency of samples contaminated by bacteria in the initial collection varied between groups. Figure 1 shows that after the initial collection, 15 (62.5%), 16 (66.7%) and 8 (33.3%) of the samples in groups A70, CHX5 and GLP0.5, respectively, did not show bacterial growth. Table 1 shows this difference considering the level of contamination according to the classification proposed by the study. The samples included in the GLP0.5 group showed to be statistically different from the CHX5 group (p= 0.04), which was less contaminated by bacteria at the beginning of the experiment, but also reaching a lower rate of decontamination after the procedures (p= 0, 02). The A70 group was not different from the CHX5 and GLP0.5 groups at the initial (p> 0.05) and final (p> 0.05) moments, when compared statistically.

After the application of the disinfection protocols, a significant reduction in bacterial contamination was observed in the three groups, all reaching a significance level of p <0.05. Considering the samples that presented initial bacterial contamination, the A70 group (n= 9) reduced 100% of the bacterial contamination. The CHX5 group (n= 8), reduced 87.5% of bacterial contamination; and the GLP0.5 group (n= 16), reduced 50% of bacterial contamination (figure 1, table 1).

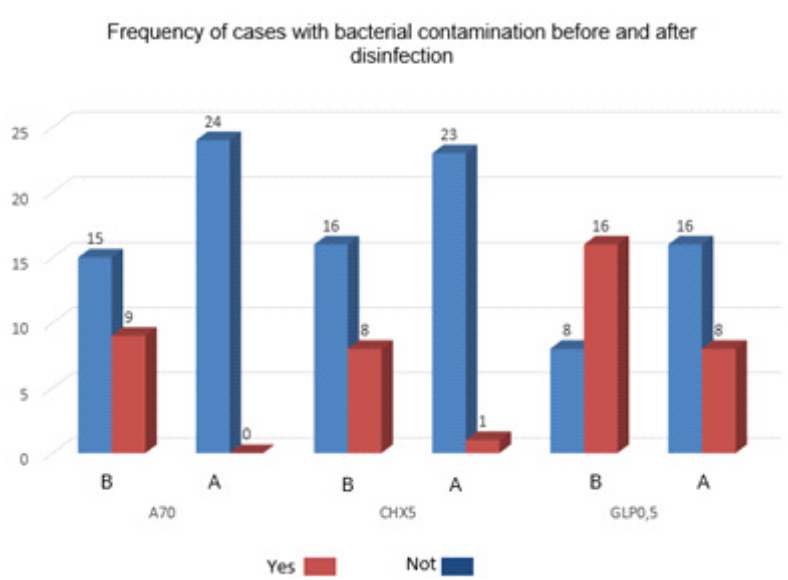


**Figure 1**. Frequency of samples with bacterial contamination before (B) and after (A) the disinfection protocols used in this study (A70: 70% alcohol; CHX5: 5% alcoholic chlorhexidine; GLP0.5: 0.5% glucoprotamine).

**Table 1**. Frequency of samples with bacterial contamination before (B) and after (A) the disinfection protocols used in this study (A70: 70% alcohol; CHX5: 5% alcoholic chlorhexidine; GLP0.5: 0.5% glucoprotamine), considering the classification of the level of bacterial contamination according to the number of Colony Forming Units (CFU) (0= none; 1= very little (≤10 CFU); 2= moderate (> 10≤50 CFU); 3= high (> 50 UFC).

| Contamination level | Disinfectants | | | | | |
|---|---|---|---|---|---|---|
| | A70 (n= 24) | | CHX5 (n= 24) | | GLP0,5 (n= 24) | |
| | B | A | B | A | B | A |
| 0 | $15^{a}$ | $24^{c}$ | $16^{a}$ | $23^{c}$ | $8^{b}$ | $16^{c}$ |
| 1 | $9^{a}$ | $0^{b}$ | $7^{a}$ | $1^{b}$ | $8^{a}$ | $2^{b}$ |
| 2 | $0^{a}$ | $0^{a}$ | $1^{a}$ | $0^{a}$ | $2^{a}$ | $0^{a}$ |
| 3 | $0^{a}$ | $0^{a}$ | $0^{a}$ | $0^{a}$ | $6^{a}$ | $6^{a}$ |

Note: Fisher's exact test at 5% significance. Equal letters indicate that there was no significant difference between samples (linear analysis). Different letters indicate that there was a significant difference between the samples (linear analysis).

After applying the disinfection protocols, considering the samples that presented initial fungal contamination, the A70 group (n= 7) reduced 28.57% of the fungal contamination. The CHX5 group (n= 6), reduced 100% of fungal contamination; having presented less contamination by fungi after the disinfection protocol performed (p= 0.04), compared to A70 and GLP0.5. The GLP0.5 group (n= 10), reduced 60% of fungal contamination (figure 2, table 2).

The frequency of samples contaminated by fungi in the initial collection varied between groups. Figure 2 and table 2 show that after the initial collection, 17 (70.8%), 18 (75%) and 14 (58.3%) of the samples in groups A70, CHX5 and GLP0.5, respectively, did not showed fungal growth. Fungal reduction was considered significantly effective only for the CHX5 group (p <0.05). For groups A70 and GLP0.5, there was no statistical significance for the reduction of fungal contamination (p> 0.05).

Figure 3 shows which locations of dental equipment had the highest frequency of bacterial contamination in the initial collection of samples, prior to the application of disinfection protocols.

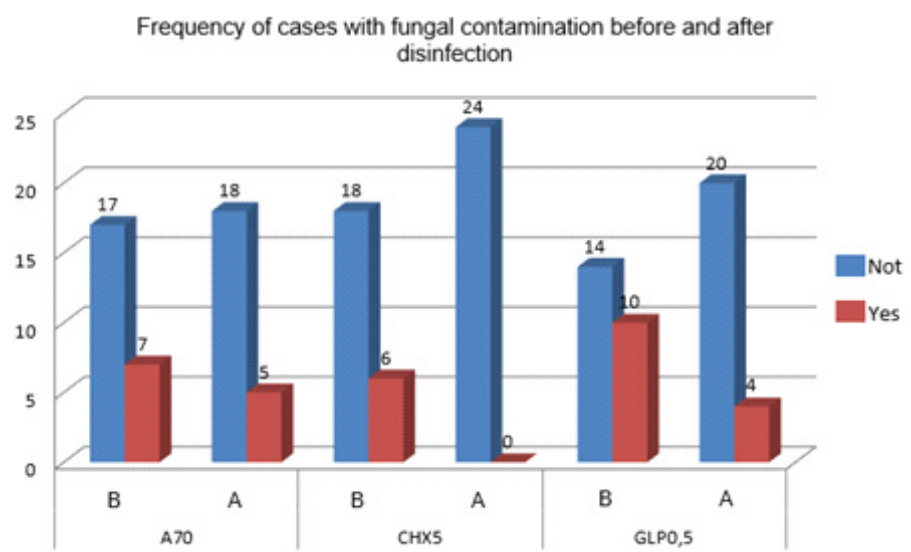


**Figure 2**. Frequency of samples with fungal contamination before (B) and after (A) the disinfection protocols used in this study (A70: 70% alcohol; CHX5: 5% alcoholic chlorhexidine; GLP0.5: 0.5% glucoprotamine).

**Table 2** Frequency of samples with fungal contamination before (B) and after (A) the disinfection protocols used in this study (A70: 70% alcohol; CHX5: 5% alcoholic chlorhexidine; GLP0.5: 0.5% glucoprotamine), considering the classification (1) with growth of fungi or (0) without growth of fungi.

| Contamination level | Disinfectants | | | | | |
|---|---|---|---|---|---|---|
| | A70 (n= 24) | | CHX5 (n= 24) | | GLP0,5 (n= 24) | |
| | B | A | B | A | B | A |
| 0 | 17[a] | 18[a] | 18[a] | 24[a] | 14[a] | 20[a] |
| 1 | 7[a] | 5[a] | 6[a] | 0[b] | 10[a] | 4[a] |

Note: Fisher's exact test at 5% significance. Equal letters indicate that there was no significant difference between samples (linear analysis). Different letters indicate that there was a significant difference between the samples (linear analysis).

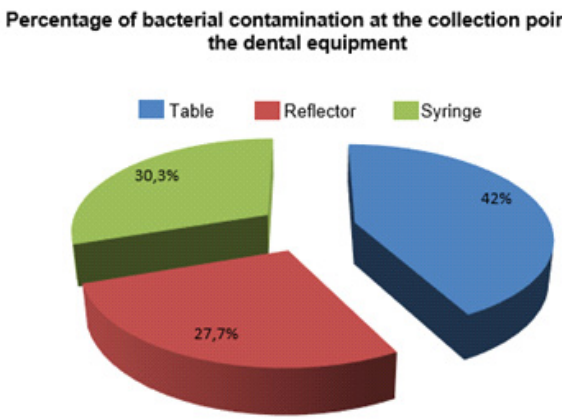


**Figure 3.** Percentage of bacterial contamination before the application of disinfection protocols by location of collection of samples from the teams.

Figure 4 shows which locations of dental equipment had the highest frequency of contamination by fungi in the initial collection of samples, prior to the application of disinfection protocols.

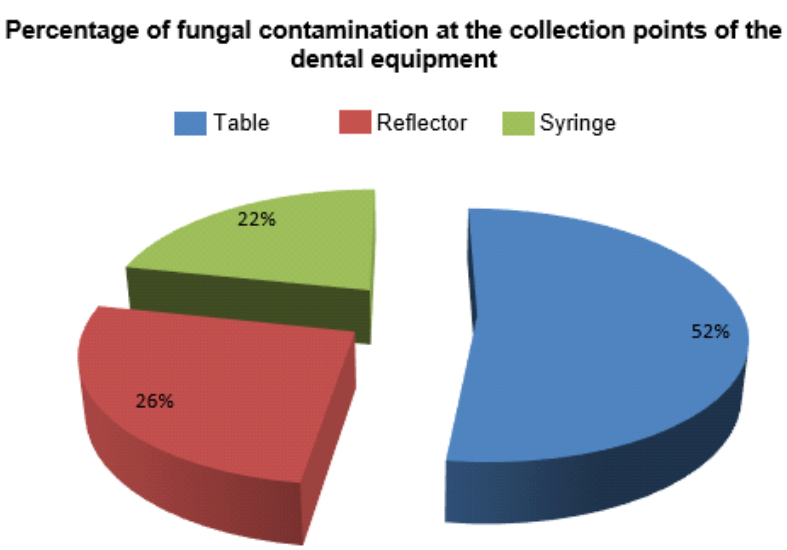


**Figure 4**. Percentage of contamination by fungi before the application of the disinfection protocols by place of collection of the samples of the teams.

Considering the presence of bacteria and fungi, no antimicrobial agent was 100% effective in eliminating microorganisms present on dental surfaces, with the best effectiveness observed, in decreasing order of antimicrobial action, of 5% alcoholic chlorhexidine, followed by 70% ethyl alcohol and 0.5% glucoprotamine.

Microscopic analysis of bacterial colonies grown in the BHA culture medium, observed after smear and Gram staining, revealed enormous bacterial diversity, with several Gram-positive genera and species (cocobacilli, coconuts, streptococci, staphylococci and bacilli), as well as the presence of cocci and gram-negative bacilli.

In a group of samples that received the treatment with the disinfecting agent glucoprotamine 0.5%, bacterial resistance occurred, showing no antimicrobial effect. The suspected microorganism was a genus / species of Gram-negative diplobacillus, not identified in this study.

## DISCUSSION

The dental environment is quite conducive to infection with infectious agents, capable of causing pathologies from the simplest to the most complex. In recent years there has been an increase in the number of infectious diseases and cross-infection [17]. According to Knackfuss et al. [18], cross-infection is the transmission of infectious agents between patients and staff, within a clinical environment, whose transmission can result from person-to-person contact or through contaminated objects, which are called agents [18]. For cross-infection to be prevented, it is necessary that standard protective measures be used during all stages of any type of clinical patient care [3]. Among these measures is the disinfection of surfaces, which must be performed in the service environments, being an extremely necessary procedure, and the substance used for this purpose must have its well-consolidated antimicrobial effects [8]. The disinfection of dental equipment should promote the reduction of the level of contamination by microorganisms and toxic proteins [11]. Thus, this study aimed to verify the contamination of dental equipment and the ability to reduce the level of contamination of different disinfectant products, 70% alcohol, 5% alcoholic chlorhexidine and 0.5% glucoprotamine.

During the treatment of a patient, several items in the office become contaminated with the microbiota from the skin, hair and oral cavity of the patient [3,6,19,20]. In a study by Umar et al. [21] contamination analysis was carried out in an orthodontic clinic, 100 samples of varied surfaces were collected, including the light reflector handle, chair, suction tips, etc. and also other objects used by the dentist, such as glasses, laptop, pens, cell phone, camera and keys. The results showed contamination by bacteria in 38 samples, 17 of these samples contained bacteria that caused nosocomial pneumonia and only one had the presence of fungi. 40% of the samples collected at the clinic were contaminated, with the handle of the reflector, the suction tips and the pens used by the dentist being the ones that most showed contamination. Still, in another study, several surfaces and objects from the clinics of the State University of Ponta Grossa (SUPG) showed contamination, citing the triple syringe, the reflector handle, the owl, the door handle of the room, among others [22]. In the present study, the tip of the triple syringe, the right handle of the reflector and the handle of the clinical table were contaminated by microorganisms, proving the microbial load present on surfaces of dental equipment resulting from patient care.

According to Harrel and Molinari [23], aerosols generated during dental care are often not visible, being a potent spreader of infections, as they carry microparticles and fluids such as blood, saliva, plaque and dental tissues, according to the author, aerosols are suspended in the air for up to 30 minutes after the end of the procedure and may contaminate the surfaces of the office and the professional when removing the protective mask at the end of the service [23]. Protocols to reduce environmental contamination through aerosols include intraoral antisepsis prior to service, absolute isolation of the operating field, correct use of personal protective equipment and disinfection of the site surfaces after service.

For infection control in dental offices, it is recommended to perform the disinfection protocol before and after patient care [2]. Handpieces, air/water syringes, reflector and controls, instrument trays and surfaces, handpiece and syringe holders, chair arms and levers, head support, laboratory taps, cupboard surfaces and drawer handles, sinktops, among others [24,25]. In this study, of the 144 sites selected for sample collection, 39 did not show bacterial growth and

49 did not show fungal growth, demonstrating that adequate measures to reduce the level of contamination of surfaces during care have been carried out in the clinics selected for the search.

A study by Almondes et al. [20] aimed to analyze fungal contamination in dental chairs at the clinic of a Higher Education Institution in Teresina (PI), and to evaluate the effectiveness of different disinfectants such as 70% alcohol and 1% sodium hypochlorite in the disinfection of different locations in the sit chair like headrest, backrest, armrest, seat and footrest. The research showed that pathogenic fungi were isolated from all chair sampling sites. The highest frequencies were found on the backrest, followed in descending order by the seat, backrest, armrest and headrest. Filamentous fungi were identified, belonging to the genera Alternaria, Aspergillus, Cladosporium, Curvularia, Drechslera, Fusarium, Penicillium and Paecillomyces. Seven chairs were disinfected with 70% alcohol and seven with 1% sodium hypochlorite, and afterwards, samples were taken again. No fungal growth was detected after disinfection with sodium hypochlorite, which was more effective than alcohol [20]. The present study corroborates the findings of Almondes et al. [20], in relation to the use of alcohol against fungi, as we did not obtain 100% reduction in the growth of this microorganism, sodium hypochlorite was not tested as a disinfectant in this study.

In dental offices, staff and patients have a high chance of being contaminated by pathogenic microorganisms, through contact with infectious lesions, secretions such as saliva and blood, contaminated instruments, interpersonal contact and also by inhaling aerosols that can carry viruses, bacteria and fungi for the respiratory tract of people present in the environment [20,26]. The inhalation of fungi can cause diseases that vary in severity, which can be allergic reactions or even pneumonia and other systemic infections [27].

A study by Oliveira et al. [28] aimed to assess the level of fungal contamination in aerosols dispersed by high-speed pens in dental clinics in Teresina, Piauí, Brazil, the samples were collected during care at two dental clinics. Petri dishes containing Sabouraud agar with chloramphenicol were opened for 15 minutes in the following locations: in front of the chair, in the partitions on the right and left of the chair, and on the neighboring bench. The plates were incubated at room temperature to allow fungal growth and subsequent identification of species. Colonies were formed in 100% of the plates, with 19 species observed, where the most frequent were: Curvularia clavata, Aspergillus niger, Phialemonium obovatum, Curvularia geniculata and Scopulariopsis koningii. All identified species are pathogenic and can develop allergic infections of the respiratory tract and even systemic infections in the patient and the dental surgeon. The results indicate that the minimum safety distance between dental chairs defended by the National Health Surveillance Agency is insufficient. Based on this, the study recommends the adoption of a minimum safety distance of more than 2 meters as well as biweekly cleaning of the air conditioning system and water lines as viable and efficient measures to reduce the formation and dispersion of fungi through aerosols. in these environments. In dental offices, where aerosols and splashes are easily generated, high-level disinfectants should be used to disinfect the site, based on the present study, 5% alcoholic chlorhexidine was the most effective chemical agent against fungi and bacteria being best suited for this purpose.

According to the literature, 70% alcohol is considered an intermediate level disinfectant, having a limited effect on some microorganisms [11]. Three applications are recommended, as follows: rub the 70% ethyl alcohol soaked in gauze, wait for it to dry and repeat the procedure 3 times, totaling an exposure time of 10 minutes [24]. Although it is not accepted as a highly effective disinfectant, this substance is widely used by the dental class mainly for its low cost, ease of acquisition, low toxicity, stability in storage, being colorless and evaporating without leaving residues in the equipment. The literature shows that although it is not the most effective disinfectant, it resulted in a significant reduction of microorganisms after its use for disinfection [6]. In a study by Graziano et al. [29] who tested disinfection with 70% alcohol (w / v) on contaminated surfaces, without prior cleaning, by rubbing for 30 seconds, showed no differences in the disinfectant efficiency of 70% alcohol (w / v) under rubbing, when applied with and without previous cleaning on surfaces contaminated with microorganisms, presenting a decrease in microbial growth, these are results that are in agreement with the present study, where after the use of 70% alcohol for the disinfection of the selected surfaces, the even it was 100% effective for the elimination of bacteria, however, as already mentioned, we obtained a lesser disinfectant effect on fungi. It was not possible to verify through the methodology of this study what would be the action of this disinfectant agent on viruses.

A study by Vidana et al. [30] aimed to evaluate the potential for nosocomial transmission of Enterococcus faecalis during root canal treatment, measuring its occurrence on dental office surfaces in relation to the effectiveness of its disinfection routines in eight dental clinics, two of which specialize in endodontics and six from general practice, sample collection was performed in duplicate after the root canal treatment procedure where samples were collected before and after surface disinfection, research showed that out of a total of 320 samples collected, 40, 6% (n= 130) exhibited bacterial growth, being mainly environmental bacteria (36.3%) and to a lesser extent salivary bacteria (3.4%). Only three surfaces, which were probably disinfected inappropriately, were positive for E. faecalis (0.9%). Surface disinfection in specialized clinics reduced contamination to 10%. In conclusion, the study revealed that the potential for transmission of E. faecalis to surfaces in the environment during dental interventions appears to be very small and that incorrect or ineffective disinfection in dental clinics needs to be addressed to counteract the risk of bacterial transmission during visits dental care.

Considering that 70% alcohol is an intermediate level disinfectant agent, other disinfecting agents have been tested for greater decontamination of surfaces in hospital and clinical environments, among them chlorhexidine and glucoprotamine, substances chosen to be tested in this study [15,16]. A study by Bambace et al. [16], showed that aqueous solutions of chlorhexidine from a concentration of 1% demonstrated greater efficiency in disinfecting surfaces when compared to aqueous solution of chlorhexidine 0.5%, alcohol 70% gel and liquid, which may indicate it for use in routine disinfection of clinical practice [16]. Another study found that the most effective disinfectant for surface disinfection was the 77° GL ethyl alcohol solution with 5% chlorhexidine, followed by 77° GL ethyl alcohol, which showed a statistically significant microbial reduction after 77° GL alcohol with 5% chlorhexidine, when compared to the phenolic compound (Duplofen) and iodophor (PVP-I) [31]. In this study, 5% alcoholic chlorhexidine was tested, which was not 100% effective in bacterial control, but was 100% effective against fungi.

Ferreira et al. [32] tested the effectiveness of three substances used in disinfecting surfaces and analyzed the prevalence of bacteria in materials used in the practice of dental radiology, at the Federal University of Pernambuco, the study was carried out in clinics through the collection of samples in heads and triggers of X-ray machines, lead apron and external surfaces of the portable darkroom, after daily visits, and after disinfection with 70% alcohol, 0.2% peracetic acid or 2.5% sodium hypochlorite. The results showed that 91.7% of the surfaces were contaminated. Of the disinfectants used, 70% alcohol was the least effective, while sodium hypochlorite 2.5% and peracetic acid 0.2% decreased the amount of bacteria from 94.8% to 6.3%, alcohol 70% decreased from 87.5% to 56.3%. When analyzing the cylinders, the researchers found that 75% of them were contaminated and with the use of alcohol the percentage of contamination of the cylinders did not decrease. In the present study, peracetic acid and sodium hypochlorite were not tested.

A recent product on the market is glucoprotamine, which is considered to have a broad antimicrobial action by the manufacturer and is widely used in hospitals [15]. Glucoprotamine is licensed in Europe as a high-level disinfectant for instruments and has, in part, replaced the use of phenolics and aldehydes. Unlike aldehydes, dilutions of glucoprotamine have limited activity against bacterial spores [14]. Of the products tested in this study, glucoprotamine at a concentration of 0.5% showed fewer antimicrobial effects, both on bacteria and fungi, with results different from other research [15] in which glucoprotamine in low concentration, 0.5%, was able to eliminate all tested bacterial isolates in just 1 minute. However, the manufacturer does not indicate this concentration, since isolates with less susceptibility to glucoprotamine may appear. That is, in the presence of more resistant microorganisms, in the presence of a high load of organic contamination or in the presence of a biofilm structure, the favorable result found in the mentioned study may not be sufficient [15]. Still, in a study by Widmer and Frei [14], which aimed to determine the in vitro efficacy of glucoprotamine in disinfecting contaminated instruments in a hospital where the instruments were immersed in saline after use and glucoprotamine was added to a 1.5% concentration, immersed for 60 minutes, showed an excellent in vitro efficacy of glucoprotamine without previous removal of proteins and debris. The excellent results obtained in this study may be related to the concentration of the product and the method used, where they used a concentration of 1.5% by immersion, unlike our tests where we used a concentration of 0.5% by friction.

In a study by Genz et al. [33] who isolated and identified microorganisms before and after disinfecting surfaces of side tables and light reflectors using 70% alcohol, 3% hydrogen peroxide, 5% sodium hypochlorite and Incidin® (glucoprotamine) showed that the most effective agents were Incidin® and sodium hypochlorite 5%, which showed

100% effectiveness, sample collections after the use of disinfectants were performed respecting the recommended action time for each agent, where the Hypochlorite 5% sodium remained in contact for 10 minutes and Incidin® for 30 minutes, these are prolonged periods, considering that the disinfection processes must be quick so that they do not occupy a long time between sessions, in addition, it was not mentioned in the study the concentration of the disinfectant based on glucoprotamine. In the present study, a microbial form (Gram-negative diplobacilli) showed resistance to the product, indicating that the concentration of 0.5% of the glucoprotamine used in this study was insufficient to reduce the level of contamination of dental equipment.

In this study, no antimicrobial agent was 100% effective in eliminating microorganisms present on dental surfaces, considering the presence of bacteria and fungi, with the best efficacy observed, in decreasing order of antimicrobial action, of 5% alcoholic chlorhexidine, followed by ethyl alcohol at 70% and glucoprotamine at 0.5%, it is showing the most unsatisfactory result in this study. Therefore, it is essential that all surfaces and materials in clinics are decontaminated before and after visits with the help of disinfectants, as well as it is important that physical barriers to protect these surfaces are used. The results obtained demonstrate the need for education, prioritizing biosafety in all procedures performed in Dentistry, using norms for routine disinfection procedures in the clinic and highlighting the risks to which the team is exposed when these procedures are neglected.

## CONCLUSION

This study confirmed the contamination of the surfaces of dental equipment and the importance of disinfection for infection control in the dental clinic. Through this research, it was found that no antimicrobial agent was 100% effective in eliminating microorganisms present on dental surfaces, considering the presence of bacteria and fungi, with the best efficacy observed, in decreasing order of antimicrobial action, of alcoholic chlorhexidine at 5%, followed by 70% ethyl alcohol and 0.5% glucoprotamine. With the completion of this study, it is concluded that professionals should be constantly applying infection control measures in dental offices. It is suggested to carry out further research aiming at a safer and more effective product for disinfecting surfaces.

### Collaborators

SCM Tonello, methodological design, sample collection, microbiological analysis and writing of the article. MJ Dutra and G Pizzolatto, sample collection and article writing. LA Giacomini, microbiological analysis. DJ Corralo, methodological design, sample collection, microbiological analysis and article review.

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