ORIGINAL ARTICLE / *ARTICLE ORIGINAL*

Disinfection / *Désinfection*

CONTINOUS MONITORING OF STERILITY: BACTERIAL CONTAMINATION AND DISINFECTANT PERFORMANCE IN DENTAL CLINICS

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Objectives: This study aimed to (1) evaluate contamination levels across three clinics (endodontic, extraction and surgery, and fixed prosthodontics), (2) identify the types and prevalence of bacteria, (3) estimate the effectiveness of a commercial disinfectant, and (4) determine the bacterial species most responsive to the disinfectant.

Methods: Equal surfaces (17.98 cm^2) were swabbed, cultured on nutrient agar for the total aerobic microbial count before and after disinfection, and analyzed using settle plates. Bacterial identification was conducted through colony characteristics, Gram staining, and biochemical tests. Data were processed using SPSS version 26.

Results: The endodontic clinic exhibited the highest contamination levels, with buttons significantly more contaminated than handles. The disinfectant effectively reduced contamination but did not eliminate it.

Conclusions: Contamination levels varied significantly between the clinics; ongoing evaluation is essential.

Keywords: Dental clinic, Bacterial contamination, Disinfectant activity, Bacterial species.

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Conflicts of interest:
The authors declare no conflicts of interest.

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SURVEILLANCE CONTINUE DE LA STÉRILITÉ : CONTAMINATION BACTÉRIENNE ET PERFORMANCE DES DÉSINFECTANTS DANS LES CLINIQUES DENTAIRES

Objectifs: Cette étude vise à (1) évaluer les niveaux de contamination dans trois cliniques (endodontie, extraction et chirurgie, et prothèses fixes), (2) identifier les types et la prévalence des bactéries, (3) estimer l'efficacité d'un désinfectant commercial et (4) déterminer les espèces bactériennes les plus sensibles au désinfectant.

Méthodes: Des surfaces égales (17,98 cm^2) ont été écouvillonnées, cultivées sur gélose nutritive pour la numération microbienne aérobie totale avant et après désinfection, puis analysées sur plaques de sédimentation. L'identification bactérienne a été réalisée par caractéristiques des colonies, coloration de Gram et tests biochimiques. Les données ont été traitées avec SPSS version 26.

Résultats: La clinique d'endodontie présentait les niveaux de contamination les plus élevés, les boutons étant significativement plus contaminés que les poignées. Le désinfectant a efficacement réduit la contamination, sans toutefois l'éliminer.

Conclusions: Les niveaux de contamination variaient significativement d'une clinique à l'autre; une évaluation continue est essentielle.

Mots clés: Clinique dentaire, Contamination bactérienne, Activité désinfectante, Espèces bactériennes.

Introduction

Infection management is regarded as an essential aspect of dental treatment. The literature indicates that inadequate disinfection of the dental environment may lead to the transmission of infectious diseases and subsequent contamination, jeopardizing the health of both patients and dental personnel. Infectious diseases can be transmitted via dentists, dental materials, and dental laboratories [1]. Due to the oral cavity's bacterial reservoir, bacteria can be transmitted to instruments and clothing during dental treatments, hence heightening the risk of cross-infection.

Patients, dental professionals, and the dental team may transmit contamination or infection among themselves [2], Clinical contact surfaces can function as reservoirs for microbial contamination upon contact. Additionally, bacteria can be transmitted between individuals through the shared use of equipment or via exposure to mucosal surfaces, such as the mouths, nostrils, or eyes, of patients and healthcare personnel [3].

A patient's susceptibility may result in the contraction of an infection from contaminated surfaces or instruments in the dental office [2-4]. Specifically, the use of air-water sprays and ultrasonic scalers in conjunction with high-velocity spinning devices generates aerosols that are contaminated with microorganisms and biological materials, including blood, saliva, and dental plaque [5-6].

Dental procedures have the potential to generate aerosols and splatter, which may lead to the contamination of healthcare professionals [7]. These aerosols are primarily contaminated with gram-positive bacteria, including viridans streptococci and staphylococci[8].

While bigger particles settle easily onto surrounding surfaces and can become contaminated during patient care, smaller ones (<5 μm) can float in the air and potentially penetrate the tiny airways of the lungs[6, 9, 10].

Pseudomonas aeruginosa, Klebsiella pneumonia, Mycobacterium tuberculosis, Legionella, Escherichia coli, and Legionella pneumophila are important microorganisms that may cause infections in dental settings; in addition, infectious agents such as the Epstein-Barr virus, Herpes Simplex virus, Human Immunodeficiency virus, Hepatitis B and C virus, and Cytomegalovirus[11-12]

A variety of bacterial infections can remain viable on surfaces for extended durations unless removed through sterilization or disinfection methods [11]. Research indicates that surfaces, water, and air may significantly contribute to the transmission of pathogens [11-13].In dental unit water systems, the accumulation of biofilm, stagnant water, and insufficient disinfection measures facilitate bacterial proliferation[11, 13, 14].

When microorganisms invade the body, locate a suitable habitat, and commence reproduction, they can lead to disease [11-15]. Certain individuals exhibit heightened concern regarding aerobic bacteria due to previous experiences with conditions such as rheumatic heart disease, mitral valve endocarditis, and issues related to prosthetic joints. From a public health perspective, infections in dental clinic settings involving antibiotic-resistant bacterial strains are particularly concerning[11]. Currently, effective infection control is regarded as crucial in dental care.

Dentists can mitigate the risk of infectious diseases transmitted via blood and saliva by following established guidelines and principles for effective disinfection, especially as the prevalence of these diseases continues to rise [16]. Routine infection control measures aimed at preventing hospital-acquired infections include the maintenance of hand hygiene, disinfection practices, and isolation protocols [17, 18].

While the use of protective covers and the cleaning and disinfection of surfaces between patients are essential, maintaining good hand hygiene and utilizing personal protective equipment, such as gloves, are also vital in reducing the risk of infection transmission via these surfaces]6[. If surfaces are not adequately covered, they should be cleaned after each treatment session[18].

Regular assessment of clinical surfaces is essential for enhancing the quality of clinical settings and infection control measures, as it enables the identification of areas requiring improvement and the implementation of corrective actions [19].

In light of this significance, the current study investigated bacterial contamination in the clinical dental environment at Al-Wataniya Private University in 2023 and evaluated the efficacy of the disinfectants employed in clinical practice.

Materials and Methods

Collection and processing of samples

This study was conducted in November 2023 to examine microbial contamination on various clinical surfaces within the Faculty of Dentistry at Al-Wataniya Private University. Samples were obtained from the surfaces of unit lamp handles, buttons controlling chair movement, and the air surrounding the units across different clinics, including surgical, endodontic, and fixed prosthodontics. The samples were collected from these surfaces using wet sterile swabs (soaked in physiological saline) and aseptic tips.

Two groups of swabs were collected: the first group was obtained from one half of the light handle and two buttons that control the movement of the dental chair. The second group was taken from the opposite half of the light handle and the remaining two buttons after the application of a commercial sanitizer (Progiene Plus, Beroea Pharma, Aleppo, Syria), which contains isopropanol (35%), ethanol (25%), and chlorhexidine (5%). Samples were collected one minute following the application of the disinfectant,

in accordance with the provided instructions, and this procedure was conducted similarly across the three previously mentioned clinics.

The swab's tip was entirely submerged in a tube containing 5 ml of sterile physiological saline, after which excess liquid was removed by pressing the swab against the tube's inner walls. The swab was then employed to collect samples from the light handle and the buttons, utilizing a zigzag motion while rotating and rubbing from one side to the other. This procedure was performed twice: first from left to right, followed by a top-to-bottom motion. Finally, the swab was placed back into its tube before being cultured on Nutrient Agar. Samples were collected from an area of 15.625 cm^2 on the light handle and 2.355 cm^2 on the buttons. The dilution-neutralization technique was employed to neutralize residual disinfectants. This involved placing a sterilized cotton swab, utilized for sampling, into 5 ml of sterile physiological saline, followed by the addition of 1% polysorbate 80.

The tubes were agitated for one minute, after which, under sterile conditions, 0.1 ml was extracted from each tube and cultured using the spread plate technique to assess the Total Aerobic Microbial Count (TAMC) by counting colony-forming units (CFU). Following the established protocol [20] , this process was carried out on nutrient agar plates in duplicate, with a negative control included. All plates were subsequently incubated at 37°C for a duration of 48 to 72 hours.

Identification of isolated bacteria

The identification of isolated bacterial species was conducted based on colony characteristics, Gram staining, and various biochemical tests, including oxidase, catalase, citrate utilization, coagulase activity, mannitol fermentation, and blood hemolysis patterns, in accordance with standard microbiological protocols [21].All tests were repeated twice to ensure the reproducibility of the results. The aforementioned microbiological analyses were carried out in the microbiological laboratory of the Pharmacy Faculty at Al-Wataniya Private University.

Settled plate method

To qualitatively assess bacterial contamination in the air of each clinic, the settle plate method was employed. Six Petri dishes, each measuring 9 cm in diameter and containing nutrient agar, were utilized. After the clinical activities were concluded, two plates were positioned in the surgery clinic, two in the fixed clinic, and two in the endodontic clinic. The plates were left uncovered for four hours, allowing sufficient time for airborne microorganisms and aerosols to settle onto the agar surface. One plate was placed 1.5 meters from the dental chair and 2 meters above the ground, while the second plate was positioned on a table occupied by employees, at a height of 1 meter above the ground.

Statistical analysis

All data were analyzed using the SPSS statistical software, version 26. A three-way ANOVA was conducted to assess the significance of the differences, with an alpha level set at 0.05 to identify statistically significant variations among the groups. Additionally, all experiments were carried out in duplicate.

Ethics approval statement

Ethical approval for the study was obtained from the Ethical Committee of Al-Wataniya Private University (4320).

Informed Consent Statement: This research did not involve any patients, and informed consent was obtained from the department.

Animal rights statement: This article does not contain any studies with animal subjects, so it has been granted an exemption by the ethical committee of Al-Wataniya Private University (4350)

Results

Table 1 displays the findings from surface swabs taken from surgical, endodontic, and fixed-site clinics

Table 1. The results of a comparative study of the effect of sterilizers on the number of bacteria on Buttons and handle surfaces in dental Clinics

Swab time			Number of colonies in a dish	Number of viable bacteria in the sample	CFU/ cm2	Swab time	Number of colonies in a dish	Number of viable bacteria in the sample	CFU/cm^2
Before Sanitization	**Extraction and Surgery Clinic**	Handle	11.00	550.00	35.20	**After Sanitization**	8.00	400.00	25.60
		Buttons	16.50	825.00	350.32		5.50	275.00	116.77
		Average	13.75	687.50	192.76		6.75	337.50	71.19
	Endodontic Clinic	Handle	7.50	375.00	24.00		3.50	175.00	11.20
		Buttons	23.00	1150.00	488.32		13.50	675.00	286.62
		Average	15.25	762.50	256.16		8.50	425.00	148.91
	Fixed prosthodontics Clinic	Handle	7.00	350.00	22.40		6.50	325.00	20.80
		Buttons	15.00	750.00	318.47		3.50	175.00	74.31
		Average	11.00	550.00	170.44		5.00	250.00	47.55

within the dental clinic at Al-Watania Private University (WPU), both prior to and following the application of the disinfection procedures outlined in the methodology section.

The data presented in the table indicate the average number of colonies recorded on the Petri dish replicates. The total viable bacterial count in each sample was computed using the formula: Total viable bacteria in the sample = number of colonies on plates × 10×5. Additionally, the table provides the viable bacterial count per 1 cm^2 of the specified area.

Overall, contamination levels were found to be greater in the endodontic and extraction/surgery clinics compared to the fixed-prosthodontics clinic. The average number of colony-forming units (CFU) was recorded as 256.16 in the endodontic clinic, followed by 192.76 in the extraction and surgery clinic, and 170.44 in the fixed-prosthodontics clinic.

Furthermore, the number of colonies was consistently higher on buttons than on handles across all clinics. Specifically, the endodontic clinic exhibited the highest average of colonies on buttons, at 488.32 CFU, followed by 350.32 CFU in the extraction and surgery clinic, and 318.47 CFU in the fixed-prosthodontics clinic.

Add to that, the percentage of reduction in the number of bacteria was more pronounced on the surface of the buttons compared to the surface of the handle, This ratio was present in the fixed clinic (17.14% handle, 76.67% buttons), the extraction and surgery clinic (27.27% handle, 66.67% buttons), and the endodontic clinic (53.33% handle, 41.30% buttons).

To confirm the significance of the differences between the reduction rates of the number of bacteria between the buttons and the handle before and after disinfection, a 3-way ANOVA analysis was performed using the SPSS statistical analysis program, version 26. The following are the results of the statistical analysis:

Table 2. 3-way ANOVA test results

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared[a]	Observed Power[b]
Corrected Model	610370.451	11	55488.223	16.591	.0	.938	1.0
Intercept	524524.318	1	524524.318	156.837	.0	.929	1.0
time	82463.261	1	82463.261	24.657	.0	.673	.995
location	372813.049	1	372813.049	111.474	.0	.903	1.0
time * location	71592.770	1	71592.770	21.407	.001	.641	.988
Error	40132.652	12	3344.388				
Total	1175027.420	24					
Corrected Total	650503.102	23					

a- Eta Squared (η^2) is a measure of the strength of the independent variable influence on the dependent variable. Eta Squared values range between 0 and 1, with 0 indicating no effect, and 1 indicating a full effect.
b- Observed Power (1-β) is a measure of a statistical test's ability to detect a real effect if it exists. Observed Power values range from 0 to 1, with 0 indicating no power, and 1 indicating full power.

Conclusions drawn from Table 2:

- There are statistically significant main effects for each of the sterilizer, the swabbing site (buttons or handle).
- There is a statistically significant interaction between the sterilizer and the swabbing site (buttons or handles).
- All Observed Power values exceeded the 0.60 limit, meaning that the experiment data was sufficient to detect statistically significant differences if they existed in reality.
- The findings from the preceding table prompt further investigation aimed at identifying the types of bacteria present on surfaces both prior to and following disinfection. This study seeks to assess the efficacy of disinfection methods against specific bacterial strains within the clinical work environment.

The impact of disinfection on the viable bacterial counts across three distinct clinics was assessed. Surface samples were taken from the handles and buttons in each clinic, both prior to and following disinfection. A surface swabbing technique was employed to quantify the number of viable colonies in each sample. Subsequently, the bacterial types present in each culture dish were identified and enumerated. Table 3 presents the averages from the experiments; however, due to the extensive dataset, the results are condensed to focus solely on the total number of colonies and the viable colony-forming units (CFU).

Table 3. Comparison of the average numbers of viable colonies of bacteria isolated in the studied clinics before and after sterilization

Swab time			Colonies count on the dish	viable bacteria count/cm2 CFU	Swab time	Colonies count on the dish	viable bacteria count /cm2 CFU
Before sterilization	Extraction and Surgery Clinic	**Bacillus spp**	5.25 **38.18%**	79.91	After sterilization	3.75 (55.56%)	34.54
		Staphylococcus aureus	2.00 **14.55%**	24.43		1.50 (2.22%)	13.82
		CoNS	5.50 **40%**	76.20		1.00 (14.81%)	16.72
		Micrococcus spp	1.00 **7.27%**	12.23		0.50 (7.41%)	6.11
		Average	3.44	48.19		1.69	17.80
	Endodontic clinic	**Bacillus spp**	4.25 **27.86%**	54.17		3.25 (38.24%)	59.99
		Staphylococcus aureus	4.75 **31.14%**	87.33		1.00 (11.76%)	16.72
		CoNS	4.75 **31.14%**	82.82		3.75 (44.12%)	61.59
		Micrococcus spp	1.50 **9.83%**	31.85		0.50 (5.88%)	10.62
		Average	3.81	64.04		2.13	37.23
	fixed- prosthodontics clinic	**Bacillus spp**	5.25 **(47.72%)**	61.88		1.25 (25%)	8.51
		Staphylococcus aureus	1.50 **(13.63%)**	22.83		0.50 (10%)	1.60
		CoNS	3.00 **(27.27%)**	59.19		2.75 (55%)	35.85
		Micrococcus spp	1.25 **(11.36%)**	26.54		0.50 (10%)	1.60
		Average	2.75	42.61		1.25	11.89

To assess the variation in responses among different bacterial types to the sterilization process and to identify which type exhibits greater sensitivity, we compared the average colony counts for each bacterial strain both before and after disinfection. The findings are presented in Table 4.

Table 4. Average number of viable colonies per species of organisms before and after Sanitization

Swab time	Microb type	Average	Standard deviation	Swab time	Average	Standard deviation	Difference
Before sanitization	Bacillus spp	65.32	58.12	After sanitization	34.34	43.06	**47.42%**
	Staphylococcus aureus	44.86	64.30		10.71	18.43	**76.12%**
	CoNS	72.74	79.84		38.05	46.18	**47.68%**
	Micrococcus spp	23.53	27.38		6.11	9.22	**74.05%**

The conclusions derived from Table 4 are as follows:

- Bacillus spp. exhibited the least susceptibility to disinfection, with a 47.42% reduction in the number of viable colonies post-disinfection.
- In contrast, *Staphylococcus aureus* showed the greatest sensitivity to disinfection, with a 76.12% decrease in viable colonies following treatment.
- Similarly, coagulase-negative staphylococci (CoNS), like Bacillus spp., were minimally impacted by disinfection, resulting in a 47.68% decrease in viable colonies.
- Micrococcus spp. demonstrated results comparable to those of Staphylococcus aureus, with a 74.05% reduction in viable colonies post-disinfection.

The analysis indicates that disinfection effectively reduced the number of viable colonies across all three clinics. However, the question remains whether this reduction is statistically significant. To address this, we performed ANOVA analysis, and the results are presented below.

The following Table 5 shows the variance analysis of differences between different bacteria.

Table 5. Results of variance analysis of differences between different bacteria

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared[a]	Observed Power[b]
Corrected Model	47709.189[a]	7	6815.598	2.862	.010	.185	.904
Intercept	131128.167	1	131128.167	55.073	.000	.385	1.000
time	20615.482	1	20615.482	8.658	.004	.090	.829
microb_type	25915.833	3	8638.611	3.628	.016	.110	.779
time * microb_type	1177.874	3	392.625	.165	.920	.006	.079
Error	209528.514	88	2381.006				
Total	388365.869	96					
Corrected Total	257237.702	95					

a- Eta Squared *(η^2) is a measure of the strength of the independent variable influence on the dependent variable. Eta Squared values range between 0 and 1, with 0 indicating no effect, and 1 indicating a full effect.*
b- Observed Power *(**1-**β) is a measure of a statistical test's ability to detect a real effect if it exists. Observed Power values range from 0 to 1, with 0 indicating no power, and 1 indicating full power.*

The results of the ANOVA analysis presented in Table 5 indicate the following:

- The analysis revealed a statistically significant difference in the number of viable colonies among all three clinics (p-value < 0.05).
- Additionally, a statistically significant difference was observed in the number of viable colonies for each type of organism (p-value < 0.05).
- However, no interaction was found between time and microbe ($p = 0.920$).

The findings from the settle plates experiment, aimed at assessing air contamination levels in the work environments of the three clinics studied, revealed that the endodontic clinic exhibited the highest number of colonies, averaging 201.5 colonies. This was followed by the extraction and surgery clinics, which had an average of 142 colonies. In contrast, the fixed-prosthodontics clinic demonstrated the lowest level of contamination, with an average of 29.5 colonies.

The statistical analysis comparing the average number of colonies across clinics indicated a statistically significant difference ($F = 106.219$, $p = 0.002$). A subsequent post-hoc analysis using Tukey's HSD test confirmed that these differences are statistically significant among all clinics.

The findings of this study indicated that the majority of bacterial isolates were gram-positive rods of the genus Bacillus spp. Following this, gram-positive cocci, including Coagulase-Negative Staphylococci (CoNS*)* and *Staphylococcus aureus*, were identified as the second most prevalent group, with Micrococcus spp ranking third. Figure 1 illustrates the distribution of bacterial percentages across the three clinics.

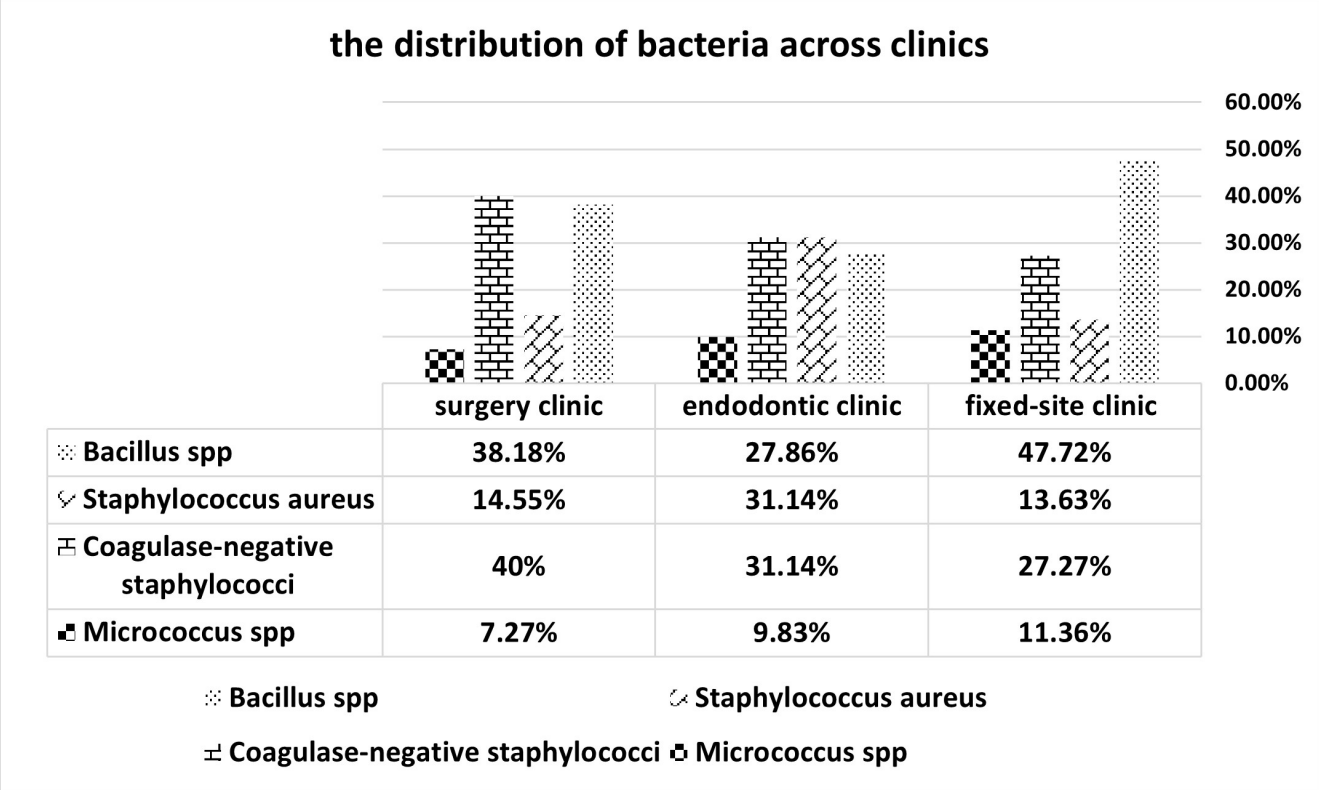

Figure 1. Distribution of microbial percentages across the three clinics examined

Discussion

Numerous studies have highlighted the risk of oral bacteria dispersing and contaminating air and surfaces during dental procedures, emphasizing the critical need for ongoing disinfection to mitigate the potential for infection transmission between patients and healthcare personnel [22]. However, it is not sufficient to rely solely on standard disinfection protocols and established protective measures. Continuous assessment of existing infection control practices and ongoing education for the oral health team is essential[23]. This need for improvement served as the impetus for conducting this research.

The findings of the present study indicated that the most frequently isolated bacteria were species of Bacillus spp., Coagulase-Negative Staphylococci (CoNS), *Staphylococcus aureus*, and Micrococcus spp., in that order. These results align with those reported by Abusalim et al. and Boccia et al [11-24]. Similar bacterial species were identified by

Ezzat et al [25], who investigated air quality in an extraction surgical clinic; however, there was a variation in the percentages of certain species. Notably, the current study revealed that Bacillus spp. had the highest prevalence, while Micrococcus spp. exhibited the lowest prevalence, which contrasts with the findings of Ezzat et al. This variation can be ascribed to disparities in geographical regions, as research by Ma et al. has indicated that geographic factors play a significant role in shaping the compositional characteristics and internal structure of oral microorganisms [26].

The investigation of surface contamination revealed that the endodontic clinic exhibited the highest level of contamination, followed by the extraction and surgical clinic, and lastly the fixed-prosthodontics clinic. The findings from the air analysis corroborated the surface contamination results, as the air contamination assessment using settle plates indicated that the endodontic clinic also had the highest contamination levels, followed by the extraction and surgical clinic, and then the fixed-prosthodontics clinic. This elevated level of contamination in the endodontic clinic may be attributed to the aerosols generated by air/water syringes, both high and low speed, during endodontic procedures, which facilitate the removal of microbes and their byproducts. Such occurrences are reported to be more frequent in endodontic practices, according to some studies [27]. Although the aerosols generated during endodontic treatment are comparatively lower than those produced in other dental specialties, the extended duration of endodontic sessions, particularly when conducted by inexperienced students, is significant. Additionally, the necessity for students to remove the rubber dam multiple times during the procedure to capture several periapical radiographs—specifically, the first to assess the length of the root canals, the second to evaluate the fit of the gutta-percha cones and confirm the apical seal, and the third to ensure the accuracy of the final root filling—should be highlighted. It is also important to note that the radiographic area is situated outside the endodontic clinic. All of the aforementioned factors may enhance the potential for contamination within an endodontic clinic.

In contrast to the singular, brief session (lasting no more than thirty minutes) needed for tooth extractions in the surgical clinic, both fixed prosthodontics and endodontic clinics necessitate multiple patient visits, each of longer duration. This requirement arises from the complexity of the procedures and the limited experience of the students. Consequently, this may contribute to heightened contamination levels in the endodontic clinic, as it results in a higher volume of patient traffic.

The endodontic treatments conducted in the clinic encompass pulpectomy, management of infected root canals, and retreatment of root canals. This diversity in procedures may elevate the risk of bacterial contamination, contingent upon the specific nature of the treatment administered.

In addition to the aforementioned reasons, the Extraction and Surgery Clinic has intensified its sterilization protocols prior to commencing surgical procedures while also ensuring the integrity of the sterilization barrier throughout the operation. These measures may contribute to a reduction in the presence of contaminants to some degree.

The findings suggest that the buttons exhibit a higher level of contamination compared to the handles across all clinics. This discrepancy may be attributed to the increased frequency of contact by medical personnel, along with the buttons' positioning directly opposite the patient's open mouth, which results in greater exposure to aerosols laden with bacteria.

Following the implementation of a 3-Way ANOVA analysis utilizing SPSS statistical software, version 26, the results demonstrate that the disinfectant employed is effective in decreasing the total bacterial count on surfaces within dental clinics. This reduction may contribute to minimizing the transmission of infections among patients and staff. It is essential to highlight that this analysis is based on a limited sample of clinics, and outcomes may vary in different contexts. Nonetheless, it represents a valuable approach to enhancing sterilization and hygiene practices in dental settings.

The results of the interaction between time and location from the ANOVA test indicate that sterilization was significantly more effective on the buttons than on the handle, with a greater percentage decrease in contamination that is unlikely to be attributed to chance. This difference may stem from the materials used in the buttons, which are smoother than the rougher plastic of the handle, potentially impeding the disinfectant's efficacy [28].

The results demonstrate that the disinfection process effectively reduced the total bacterial count in all three clinics. Specifically, *Staphylococcus aureus* and Micrococcus spp. displayed heightened sensitivity to the disinfection treatment compared to other bacterial species. Nonetheless, the lack of an interaction effect (time*microb*type) in the ANOVA analysis indicates that the sterilizer's effectiveness was uniform across various bacterial types, with differences in response among bacterial genera likely due to other influencing factors.

Conclusion

- The current study aimed to assess the prevalence of bacteria on various surfaces in three dental clinics at Al-Wataniya Private University, both prior to and following the application of disinfectants.
- The findings revealed that the tested surfaces exhibited a level

of contamination that warrants attention.

- There were significant differences in contamination levels among the clinics, likely attributable to the specific clinical practices employed at each location, with the most commonly isolated bacteria being Bacillus species, coagulase-negative staphylococci (CoNS), *Staphylococcus aureus*, and Micrococcus spp.
- It may be advantageous to relocate the peripheral radiography unit to the endodontics clinic, as this would eliminate the necessity for students to transfer patients outside the clinic for imaging purposes.
- Implementing digital periapical radiography in the endodontics clinics could be beneficial, as it would allow patients to remain seated in the same treatment chair during radiographic procedures. This approach would minimize unnecessary movement and subsequently reduce the risk of contamination.
- The disinfectant utilized was effective in significantly reducing bacterial counts; however, it did not completely eliminate them.
- Therefore, ongoing evaluation of disinfection effectiveness in dental clinics is essential to minimize the risk of infection transmission and to safeguard students, healthcare providers, and visitors.

Funding statement

The authors received no financial support for the research, authorship, and publication of this article

Authors' contributions

All authors have participated in writing the manuscript and reviewed the literature. NS did the statistics and the relevant tables. NS, SA, and NM critically and linguistically revised the manuscript. NS, and TA prepared and revised the final manuscript. NS, SA, and TA supervised the conduct of the study. All authors read and approved the final manuscript.

Acknowledgments

I would like to recognize the assistance that I received from Laboratory technician Tasneem Nouh for her dedication and sincerity toward her work.

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