Dentistry 3000
Vol 13 No 1 (2025) DOI 10.5195/d3000.2025.818

Study the Effect of Chemical Solutions on Disinfection in Prosthodontics Clinic Using Digital Ultrasonic Cleaner

Hala M. Al-Kateb

College of Dentistry, University of Mosul, Iraq

Abstract

Objective: The disinfection measures used by dentists are inadequate and require the education and enhancement of dental practitioners' skills to improve the safety of patients receiving treatment at dental offices. In a medical setting, the remaining bacteria that naturally exist on a patient's body, known as endogenous flora, often leads to the transmission of infections. The objective of this study was to identify a simple and precise technique for disinfecting a prosthodontics clinic through the utilization of a chemical solution.

Methods: Swabs were collected from the patients who wear a complete denture who were contaminated, both before and after being exposed to a sterilization system. By measuring the turbidity and absorbance at 620nm using a UV spectrophotometer, we can determine the characteristics of the broth after it has been incubated at 36.5°C for 24 hours. Utilized a solution containing 0.5% sodium hypochlorite and 2% chlorhexidine. The bacterial growth was subjected to two rounds of exposure to two chemical disinfectants, each for durations of 90 seconds and 180 seconds respectively.

Results: The bacterial growth exhibited a decrease after being treated to a chemical disinfectant in a time-dependent way.

Conclusion: This study determined that the chemical solution effectively reduces bacterial development within a short period of time, providing the most convenient, rapid, and precise approach for disinfecting dental materials.

Keywords: Chemical Disinfectant, Dental Materials, Prosthodontics Clinic.

Citation: AL-Kateb HM. (2025) Study the Effect of Chemical Solutions on Disinfection in Prosthodontics Clinic Using Digital Ultrasonic Cleaner. Dentistry 3000. 1:a001 doi:10.5195/d3000.2025.818
Received: December 30, 2024
Accepted: February 12, 2025
Published: February 14, 2025

Email: halamowwafaq@uomosul.edu.iq

Introduction

Dental prostheses that can be easily taken out are a significant therapy choice for individuals aged 65 and above who have missing teeth. The advent of digitalization and advancements in material science have led to the development of numerous innovative techniques and clinical protocols for manufacturing dentures [1]. Ensuring the cleanliness of dentures is crucial for preserving the well-being of the underlying tissues. The task of cleaning dentures can be particularly difficult for elderly individuals, especially those who have limited ability to use their hands effectively. Therefore, it is frequently recommended to employ chemical cleaning methods, such as employing denture cleaning solutions, either on their own or in combination with mechanical cleaning. These denture cleaners employ diverse methods to eliminate stains, grime, and bacteria from the surfaces of dentures [2,3]. Ultrasonic devices are mechanical aids generally used by professionals. The mechanical cleansing activity of the device is complemented with the concomitant use of a chemical solution. Ultrasound has two mechanisms of action, the first being the movement of liquid resulting from sound waves

Dentistry 3000
Vol 13 No 1 (2025) DOI 10.5195/d3000.2025.818

transferred to the liquid (vibration), and the second, the collapse of bubbles formed by vibration of the unit. Denture cleansers possess a bleaching property that causes a modification in the color of the denture basic materials, resulting in an aged and weathered appearance. The occurrence of these color fluctuations often leads to patient dissatisfaction and concerns over the functionality of the prosthesis [3-5].

The surfaces in a dental operatory that require disinfection or sterilization are classified into three categories: critical, semi-critical, and noncritical. According to the CDC, critical objects are defined as items that have a significant potential to cause illness if they come into touch with any disease-causing microorganism. These goods include surgical instruments, dentistry equipment, and ultrasound probes [6,7]. It is necessary to sanitize all essential items, usually by applying heat. Heat-sensitive operating rooms can undergo treatment with a liquid chemical sterilant that contains specified disinfection concentrations of phenol solutions, glutaraldehyde, peracetic acid, and hydrogen peroxide [8]. Equipment that makes direct contact with mucous membranes or damaged skin is classified as semi-critical. Semi-critical objects typically do not necessitate the use of high-level disinfectants. Operatory equipment that directly touches intact skin is categorized as noncritical. Computers, countertops, and floors are examples of this categorization. Mops and disinfectant wipes are suitable for disinfecting noncritical areas. The process of on-contact disinfection requires the use of disposable wipes that can only be used once. Additionally, when it comes to cleaning noncritical areas of the floor, it is often necessary to mop the floor using a liquid material [9]. Research indicates that dentists' disinfection processes are inadequate, highlighting the urgent need to educate and enhance the expertise of dental practitioners to enhance the protection of patients seeking treatment at dental offices. It is widely recognized that the remaining indigenous microorganisms, or bacteria present on a patient's body, often contribute to the spread of infections in a medical setting. When the naturally occurring microorganisms in our body come into touch with surfaces, equipment, or dental and medical instruments that have not been properly cleansed, they can create an environment that promotes the growth of different viruses and bacteria. Disinfection is considered crucial in a medical setting to counteract the emergence of germs from anatomical cavities. [10,11] In this study, a chemical solution is utilized to examine the impact of sterilization on dental prints.

Materials and Methods

In this work, we employed LB broth (made according to the method outlined by MacWilliams and Liao [12]) to evaluate the efficacy of an ultrasonic cleaner in achieving sterilization. We investigated the use of several solutions and varied durations of cleaning. The patients were randomly assigned to groups each using one of the following hygiene methods (n=40) Swabs were collected from a complete denture who was contaminated, both before and after being exposed to a sterilization system. ultrasonic vibration (Ultrasonic Cleaner, modelo2840 D – Odontobrás Ind. e Com. Equip. Méd. Odont. Ltda, Ribeirão Preto, SP, Brazil) for 15 min, performed by a professional by measuring the turbidity and absorbance at 620nm using a UV spectrophotometer, the broth can be analyzed after being incubated at 36.5°C for 24 hours. Utilized a solution containing 0.5% sodium hypochlorite and 2% chlorhexidine. The bacterial

Dentistry 3000
Vol 13 No 1 (2025) DOI 10.5195/d3000.2025.818

growth was subjected to two rounds of exposure to two chemical disinfectants, each lasting 90 seconds and 180 seconds respectively.

Statistical Analysis

The collected data were analyzed by using paired T. test compared before and after exposed to disinfectant. The significant is with *P< 0.05.*

Results

The results demonstrated a significant decrease (P < 0.05) in bacterial growth after exposure to disinfectants, which was dependent on the duration of exposure. This is illustrated in Figure 1. Prior to exposure to the disinfectant, the bacterial growth in the swab showed clear turbidity (+ve), whereas no turbidity was observed in the swab after exposure to the disinfectant. Figure 2 displayed the analysis results of optical density, which was used to quantify the density of bacterial growth. The results indicated a significant drop (P < 0.05) in bacterial growth following exposure to disinfectants, with the extent of decline dependent on the duration of exposure. However, there is no discernible disparity in the efficacy of hypochlorite sodium solution and chlorhexidine in eradicating germs.

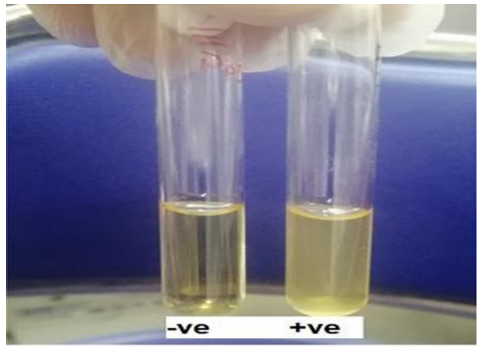

Figure 1. Bacterial growth before and after exposed to chemical disinfectants.

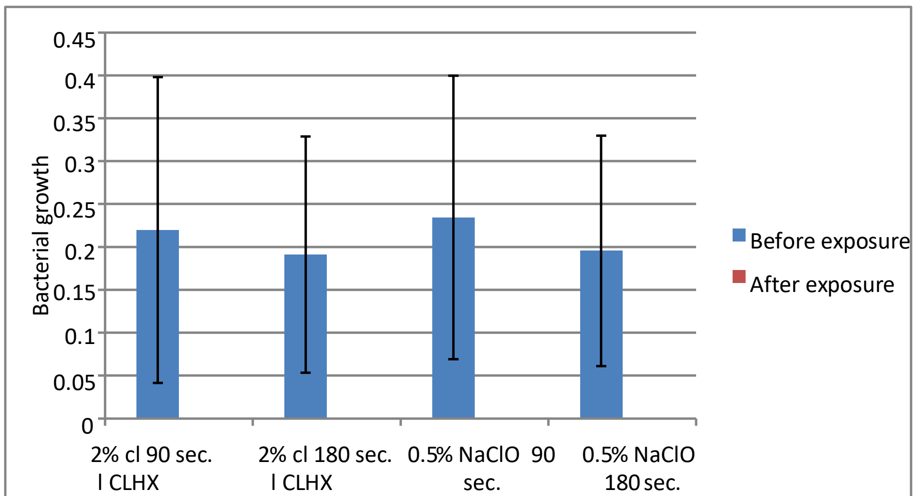

Figure 2. Bacterial growth before and after exposed to chemical disinfectants.

Discussion

While the probability of transmission of infection from dental operatory equipment to a patient was formerly considered to be low, it does really exist. To mitigate the risk, prioritize the implementation of authorized infection control protocols, including the utilization of protective barriers, optimal interface disinfection, and sterilization techniques. [13] Multiple research studies have been conducted and published on topics such as air needle pollutants and decontamination, microbial contamination and dental unit disinfection, and decontamination of principal impression materials.

However, there have been relatively few studies that specifically focus on surface disinfection protocols, especially those related to dental operatory surfaces. One potential reason is that the CDC categorized operatory surfaces as non-essential due to the absence of direct contact between the surfaces and the oral cavity [10-15].

The commonly employed chlorinated disinfectant, hypochlorite, is accessible in liquid

Dentistry 3000
Vol 13 No 1 (2025) DOI 10.5195/d3000.2025.818

(e.g., sodium hypochlorite) and solid (e.g., calcium hypochlorite) states. In the United States, chlorine products refer to aqueous solutions containing sodium hypochlorite, with concentrations ranging from 5.25% to 6.15%. These solutions are commonly referred to as home bleach. These antibacterial agents have a wide range of effectiveness against different types of bacteria. They do not leave any harmful residues, are cost-effective, act rapidly, and are not influenced by the level of water hardness. Additionally, they have a reduced level of harm and effectively remove desiccated and solidified organisms as well as biofilms from surfaces [16,17].

Previous investigations have examined the impact of sodium hypochlorite solution and 2% chlorhexidine on the eradication of Enterococcus and Bacillus bacteria. [18] Various chemicals have been suggested as efficient irrigant therapies for disinfecting root canals. Sodium hypochlorite is often used in endodontic therapy due to its strong antibacterial properties and ability to break down organic tissues [19]. However, there is no agreement on the most effective concentration of sodium hypochlorite.

Based on a study, the utilization of sodium hypochlorite at concentrations of 0.5% and 3% resulted in a substantial reduction of germs within the root canal [20]. A separate investigation revealed that after employing chemomechanical endodontic preparation in conjunction with 2.5% sodium hypochlorite, there was a significant reduction in the bacterial variety within the root canal [21]. The exceptional organic solvent properties of sodium hypochlorite enhance its effectiveness as an irrigant agent by killing microorganisms. However, sodium hypochlorite can potentially cause irritation to the tissues surrounding the apex of the tooth, especially when used in large amounts [22,23].

The study's findings revealed no statistically significant disparities in the antimicrobial efficacy between sodium hypochlorite solution and chlorhexidine. This finding was documented in the research [24,25]. Prosthodontics is recognized as one of the dental specialties that routinely neglects to employ cross-infection control measures during clinical and laboratory operations. The surveyed dentists expressed skepticism over the probability of cross-contamination between the dental clinic and laboratory. Dental laboratory environments might be susceptible to microbial contamination through many routes, such as the utilization of felt discs and pumice during the polishing procedure, as well as direct contact with contaminated hands. Additional forms of contamination arise when prostheses are brought to dental clinics for alterations or repairs, as bacteria from the patient's mouth may contaminate these materials during certain stages of treatment [26]. Variances in prosthetic surfaces affect the ability of microbes to adhere. The presence of surface roughness on prosthetic surfaces can lead to small injuries in oral tissues. Surface roughness also facilitates the colonization of microbes, which indirectly leads to tissue injury [27]. It is crucial to prioritize the use of disinfectant to maintain cleanliness and decontaminate dental prints or other equipment. The crucial aspects are the procedures employed and the specific chemicals that provide rapid and precise disinfection.

Conclusion

This study determined that the chemical solution may effectively reduce bacterial development in a short period of time, providing the most convenient, rapid, and precise approach for disinfecting dental materials.

Dentistry 3000
Vol 13 No 1 (2025) DOI 10.5195/d3000.2025.818

References

1. Ettinger R. Oral health needs of the elderly--an international review. Commission of Oral Health, Research and Epidemiology Report of a Working Group. Int Dent J. 1993; 43(4): 348-54. Available from: https://pubmed.ncbi.nlm.nih.gov/8276519.

2. Lim T. W., Burrow M. F., McGrath C. Efficacy of ultrasonic home-care denture cleaning versus conventional denture cleaning: A randomized crossover clinical trial. J. of Dent. 2024; 148, 105215. https://doi.org/10.1016/j.jdent.2024.105215

3. Saraç D, Saraç YS, Kurt M, Yüzbaşioğlu E. The effectiveness of denture cleansers on soft denture liners colored by food colorant solutions. J Prosthodont. 2007; 16(3): 185-91. doi: https://doi.org/10.1111/j.1532849x.2006.00170.x.

4. Ozyilmaz OY, Kara O, Akin C. Evaluation of various denture cleansers on color stability and surface topography of polyetherketoneketone, polyamide, and polymethylmethacrylate. Microsc Res Tech. 2021; 84(1): 3-11. doi: https://doi.org/10.1002/jemt.23558.

5. Zidan S, Silikas N, Haider J, Yates J. Effect of cleansers on the colour stability of zirconia impregnated PMMA Bio-Nanocomposite. Nanomaterials (Basel). 2020; 10(9): 1757. doi: https://doi.org/10.3390/nano10091757.

6. Almoula N., Al-Omari A. Effectiveness of sterilization by microwave irradiation on polyvinyl siloxane contaminated with Candida Albicans: An in vitro study. *Al–Rafidain Dent J*. 2024; 24(1), 81-86. http://doi:10.33899/RDENJ.2024.134911.1170

7. Almoula, N., & Al-Omari, A. (2024). Effectiveness of microwave sterilization on surface roughness of polyvinyl siloxane impression material. Al- *Al–Rafidain Dent J*. 2024; 24(1), 73-80. http://doi:10.33899/RDENJ.2024.134961.1171

8. Ahmed, M., Hasan, N., Saeed, M., & Abdulmajeed, A. (2024). Response of exposed pulp to capping with mineral trioxide aggregate mixed with hyaluronic acid as a water substitute. *Al–Rafidain Dent J*. 2024; 24(1), 191-202. http://doi: https://doi.org/10.33899/rdenj.2024.147417.1250

9. Marei HF, Alshaia A, Alarifi S, Almasoud N, Abdelhady A. Effect of steam heat sterilization on the accuracy of 3D printed surgical guides. Implant Dent. 2019; 28(4): 372-77. doi: https://doi.org/10.1097/id.0000000000000908.

10. Matsuda JK, Grinbaum RS, Davidowicz H. The assessment of infection control in dental practices in the municipality of São Paulo. Braz J Infect Dis. 2011; 15(1): 45-51. doi: https://doi.org/10.1016/S1413-8670(11)70139-8.

11. Block SS. Disinfection, Sterilization, and Preservation. Lippincott Williams & Wilkins; 2001.

12. MacWilliams MP, Liao MK. Luria Broth (LB) and Luria Agar (LA) Media and Their Uses Protocol. 2006. Available from:https://asm.org/getattachment/5d82aa34b514-4d85-8af3-aeabe6402874/LB-Luria-Agarprotocol-3031.pdf.

13. Araujo MW, Andreana S. Risk and prevention of transmission of infectious diseases in dentistry. Quintessence Int. 2002; 33(5): 376-82. Available from: https://www.quintessence-publishing.com/deu/en/article/839204/quintessence-international/2002/05/riskand-prevention-of-transmission-of-infectious-diseasesin-dentistry.

14. Williams HN, Johnson A, Kelley JI, Baer ML, King TS, Mitchell B, Hasler JF. Bacterial contamination of the water supply in newly installed dental units. Quintessence Int. 1995; 26(5): 331-7. Available from: https://www.quintessence-publishing.com/deu/en/article/838352/quintessence-international/1995/05/ bacterial-contamination-of-the-water-supply-in-newlyinstalled-dental-units.

15. Bock JJ, Fuhrmann RA, Setz J. The influence of different disinfectants on primary impression materials. Quintessence Int. 2008; 39(3): e93-8. Available from: https://www.quintessence-publishing.com/deu/en/article/839975.

16. Kohn WG, Harte JA, Malvitz DM, Collins AS, Cleveland JL, Eklund KJ. Guidelines for infection control in dental health care settings--2003. J Am Dent Assoc. 2004; 135(1): 33-47. doi: https://doi.org/10.14219/jada.archive.2004.0019.

17. Mupparapu M, Kothari KRM. Review of surface disinfection protocols in

Dentistry 3000
Vol 13 No 1 (2025) DOI 10.5195/d3000.2025.818

dentistry: a 2019 update. Quintessence Int. 2019; 50(1): 58-65. doi: https://doi.org/10.3290/j.qi.a41337.

18. Subha N, Prabhakar V, Koshy M, Abinaya K, Prabu M, Thangavelu L. Efficacy of peracetic acid in rapid disinfection of Resilon and gutta-percha cones compared with sodium hypochlorite, chlorhexidine, and povidone-iodine. J Endod. 2013; 39(10): 1261-4. doi: https://doi.org/10.1016/j.joen.2013.06.022.

19. Zehnder M. Root canal irrigants. J Endod. 2006; 32(5): 389-98. doi: https://doi.org/10.1016/j.joen.2005.09.014.

20. Wong DT, Cheung GS. Extension of bactericidal effect of sodium hypochlorite into dentinal tubules. J Endod. 2014; 40(6): 825-9. doi: https://doi.org/10.1016/j.joen.2013.09.045.

21. Rôças IN, Siqueira JF, Jr. Identification of bacteria enduring endodontic treatment procedures by a combined reverse transcriptase-polymerase chain reaction and reverse-capture checkerboard approach. J Endod. 2010; 36(1): 45-52. doi: https://doi.org/10.1016/j.joen.2009.10.022.

22. Gernhardt CR, Eppendorf K, Kozlowski A, Brandt M. Toxicity of concentrated sodium hypochlorite used as an endodontic irrigant. Int Endod J. 2004; 37(4): 272-80. doi: https://doi.org/10.1111/j.0143-2885.2004.00804.x.

23. de Sermeño RF, da Silva LA, Herrera H, Herrera H, Silva RA, Leonardo MR. Tissue damage after sodium hypochlorite extrusion during root canal treatment. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009; 108(1): e46-9. doi: https://doi.org/10.1016/j.tripleo.2008.12.024

24. Rôças IN, Siqueira JF, Jr. Comparison of the in vivo antimicrobial effectiveness of sodium hypochlorite and chlorhexidine used as root canal irrigants: a molecular microbiology study. J Endod. 2011; 37(2): 143-50. doi: https://doi.org/10.1016/j.joen.2010.11.006.

25. Jiang YP, Liu X, Zhu K. Letter to the Editor: Extracorporeal Shock Wave Therapy Combined With Oral Medication and Exercise for Chronic Low Back Pain. Arch Phys Med Rehabil. 2022; 103(7): 1499. doi: https://doi.org/10.1016/j.apmr.2022.02.022.

26. Cotrim LEF, Santos EMd, Jorge AOC. Procedimentos de Biossegurança Realizados por CirurgiõesDentistas e Laboratórios Durante a Confecção de Próteses Dentárias. Rev Odontol UNESP. 2013; 30(2): 233-44. Available from: https://revodontolunesp.com.br/journal/rou/article/5880179a7f8c9d0a098b47f3.

27. Williams DW, Lewis MA. Isolation and identification of Candida from the oral cavity. Oral Dis. 2000; 6(1): 3-11. doi: https://doi.org/10.1111/j.16010825.2000.tb00314.x.

28. Pitt WG, Ross SA. Ultrasound increases the rate of bacterial cell growth. Biotechnol Prog. 2003;19:1038-44

29. Shay K. Denture hygiene: a review and update. J Contemp Dent Pract. 2000; 1:1-8