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The Efficacy of Available Denture Products on the Reduction of Bacterial Load in Denture Wearers. A Review

Aryan Abbi and David Gillam*

*Institute of Dentistry, Barts and the London School of Medicine and Dentistry, Queen Mary University, London, UK.

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***Corresponding Author:** Professor. David G Gillam, Institute of Dentistry, Barts and the London School of Medicine and Dentistry, Queen Mary University, London, UK.

Abstract

Recently, the link between oral and systemic health has been widely researched with growing evidence that there is a relationship between the two, however in the partially and totally edentulous individual, bacterial colonisation on the denture remains a significant challenge. The aim of this review is to evaluate the efficacy of widely available denture cleaning methods such as mechanical brushing, chemical solutions, and recent technological advancements such as ultrasonic cleaning in the available literature. It was evident, that although all the reported methods contributed to a reduction in the bacterial load, user compliance was a big factor impacting on the results as well as the cleaning duration and material compatibly of the products in question. For example, the advantages of the mechanical methods included simplicity although thoroughness may not be consistent with each cleaning session. Chemical solutions provided better antibacterial action although these solutions did pose the risk of compromising the structure of the material. Ultrasonic cleaning methods showed promising results especially in combination with a cleaning tablet. Key gaps in the published literature include inconsistent methodologies and consistency in user compliance which was very difficult to measure. This review concludes by posing the question: Are denture cleaning solutions more effective than mechanical brushing methods in reducing bacterial load and how does patient compliance effect these outcomes?

Introduction

According to the Adult Oral Health Survey (2021) at last 6% of UK adults have no natural teeth and a consequence most of these individuals wear either a partial or complete

(full) dental prosthesis. For example, eleven per cent of adults reported that they had a denture, including 7% who reported they had a denture in their upper jaw only, 3% had a denture in both their upper and lower jaws with 1% who reported they had a denture in their lower jaw only. Good denture hygiene, therefore, is extremely important for both oral and systemic health. Focusing on oral health, good denture hygiene is vital in preventing oral diseases such as periodontitis, denture stomatitis and reducing likelihood of mucosal lesions due to improper cleaning resulting in plaque build-up. Inadequate denture hygiene can lead to a build-up of a biofilm, a dense microbial layer composed of microorganisms which attach to surfaces and provide an ideal environment for cells to exchange genetic material between themselves (Donlan, 2002).

Adequate removal of this biofilm reduces the accumulation of bacteria which results in the reduction of unpleasant odours and discoloration and staining of acrylic resins (Cruz et al., 2011). Furthermore, the longevity of the denture can also become compromised due to inadequate cleaning. The accumulation of debris can result in a decrease in functionality of the denture and can cause issues with the aesthetics. It was also reported that those with good denture hygiene appeared to have better oral health than those with inadequate cleaning. This included reduced gingival bleeding and better periodontal conditions in partially dentate patients (Turgut Cankaya et al. 2020). Regarding systemic health, pathogenic and potentially fatal bacteria can enter the bloodstream in those with periodontal disease with infected oral tissue which can lead to systemic infection and even death in the susceptible patient. It may also affect chronic diseases where oral infections can exacerbate systemic issues, this emphasises the importance of good denture hygiene and why those who have an increases likelihood of chronic issues such as in the older population must take good care of their dentures (Turgut Cankaya et al., 2020). The oral microbiome consists of many different microorganisms such as bacteria, fungi, viruses and protozoa, these can multiply very quickly and environments such as the oral cavity provide the perfect breeding ground for these conditions due to the moisture, temperature and access to substances e.g., sugar which can accelerate growth. These factors combined with age, fit, material of the denture and reduced salivary rate result in the colonisation of bacteria on denture surfaces (Olms et al., 2018). One study reported that saliva containing bacteria present on denture surfaces can be aspirated and once in the lungs can cause pneumonia and colonise the pharynx (Sumi et al., 2003). As well as lung infections, these microorganisms can also cause gastrointestinal infections if swallowed (Cruz et al., 2011).

The results from these studies emphasise the importance of the maintenance and effective cleaning of the dental prosthesis (denture) in the prevention of these conditions. According to a Cochrane Review by de Sousa et al. (2009) there was a lack of evidence (e.g. the lack of well-designed randomised clinical trials [RCTs]) regarding the comparative effectiveness of the different denture cleaning methods assessed in their review. The aim(s) and objective(s) of this review, therefore, was to evaluate the effectiveness of current denture cleaning methods such as chemical, mechanical, and ultrasonic as well as consider the various factors and variables involved in each method. It is also important to highlight the significance of improving denture hygiene practices and to encourage patient awareness of the importance of cleaning their dentures and to educate them on the oral microbiome.

Methodology

To summarise the scope of this review, a search strategy was used where databases such as PubMed were searched using keywords and results filtered based on relevancy.

Inclusion Criteria:

- Clinical trials, systematic reviews, and lab-based experiments that evaluate the effectiveness of denture cleaning methods written in English.

- Studies that assess bacterial load reduction on acrylic-based dentures.
- Research examining chemical, mechanical, or combination denture cleaning techniques.
- Studies including adult participants wearing full or partial dentures.
- Articles reporting on patient compliance, cost-effectiveness, reproducibility, and time efficiency of cleaning methods.

Exclusion Criteria:

- Research focusing on fixed prosthetics, natural teeth, or orthodontic appliances instead of dentures.
- Case reports, opinion pieces, or editorials lacking empirical data.
- Studies assessing antifungal or antimicrobial treatments unrelated to routine denture cleaning.
- Research with small sample sizes (<10 participants) or inadequate methodology (e.g., lack of control groups).
- Articles where full text is not accessible or lacks sufficient details on methodology and outcomes.
- Reports not written in English

Types of Denture Cleaning Methods

The types of denture cleaning methods focused on in this review are 1) mechanical cleaning, 2) chemical cleaning, 3) ultrasound, and 4) other innovative methods and combination methods for example both mechanical and chemical cleaning.

1. Mechanical Cleaning

Mechanical cleaning involves using a brush and water to clean the denture. The type and brand of brush used varied greatly between each trial and patient however the most common type of brush used was a toothbrush and a single tufted Bitufo toothbrush (Cruz et al., 2011). Techniques varied across each study with variations between the brushing technique, which was difficult to measure and was user dependent. Mechanical cleaning has both advantages and disadvantages. Brushing is the most common method of denture cleaning, and this may be due to its effectiveness, low complexity and low cost. However, those individuals that have poor manual dexterity or suffer from motor incoordination may struggle with this method. Brushing also increases wear on denture resins reducing the potential longevity of the denture (Cruz et al., 2011).

2) Chemical Cleaning

Chemical cleaning methods can be divided into groups based on their chemical composition and mechanisms. Examples of the type(s) of chemical denture cleaners, their composition and mechanism of action can be summarised below (Table 1).

Type	Composition	Mechanism of Action	Additional Notes
Hypochlorites	Sodium hypochlorite (e.g., diluted bleach)	- Breaks down organic deposits (e.g., plaque, food debris) - Kills bacteria and fungi	- Can corrode metal parts of dentures - Should be used for short periods to avoid damage.
Peroxides	Hydrogen peroxide, sodium perborate, sodium percarbonate	- Releases oxygen bubbles that mechanically remove debris - Antimicrobial action	- Effective against stains and biofilm - Safe for daily use.
Enzymes	Proteases, lipases, amylases	- Break down proteins, fats, and	- Commonly used in denture

		carbohydrates in plaque and food debris	cleaning tablets - May not kill microbes directly.
Acids	Diluted acids (e.g., citric acid)	- Dissolves mineral deposits (e.g., tartar)	- Prolonged use may damage denture material - Should be used with caution.
Crude Drugs	Plant extracts (e.g., neem, tulsi, clove oil)	- Natural antimicrobial and anti-inflammatory properties	- Limited clinical evidence - May offer mild cleaning and antimicrobial effects.
Mouthwashes	Antimicrobial agents (e.g., chlorhexidine, essential oils)	- Reduces microbial load and prevents biofilm formation	- May stain dentures with prolonged use - Suitable as an adjunct to other cleaning methods.

Table 1: Summarising multiple chemical cleansing methods and their composition, mechanism of action and any additional notes (Acknowledgement Cruz et al., 2011).

3) Ultrasound and 4) Other Innovative methods such as denture cleansing tablets

Ultrasonic baths are mainly used by professionals although they are slowly becoming more popular to consumers with products such as Zimadental and Akua Sonic which are mainly marketed on social media. Ultrasonic baths are often combined with a chemical solution and have two mechanisms of action. One mechanism from the movement of liquid resulting in a cavitation effect where the bubbles implode and secondly from bubbles collapsing because of the vibration (Cruz et al., 2011). The use of a denture cleansing tablet with an ultrasonic was also shown to be more effective than using ultrasonic alone. Although not specifically evaluated in this review several investigators have advocated the use of photodynamic therapy (PDT) or microwave application as an alternative disinfection method of complete dentures (e.g., microwaving at 650 W for 2-3 minutes) (Ribeiro et al. 2009, 2012 cited by Papadiochou &, Polyzois 2018). A later study by Aslanimehr et al. (2018) also used microwaving at 650 W, for 3 min with an alkaline peroxide tablet, (Corega®) and 2% glutaraldehyde compared to brushing and microwaving alone. The results from this indicated that the dentures contaminated with C. albicans were completely disinfected in both the short term and long term. Sharma et al. (2013) also showed that long microwaving for six min in the presence of water or denture cleansing solution was effective for both disinfection of the denture together with 100% stain removal. It is evident, however, that more studies are required to evaluate these innovative methods.

Comparative Analysis

Comparing the results from the different studies, one study reviewed the effectiveness of chemical denture cleansers, using an alkaline peroxide-effervescent tablet and ultrasonic methods in removing the biofilm in complete dentures. The investigators also combined both methods and compared them to a control of brushing with water where 80 complete denture wearers participated for 21 days. The biofilm was quantified by using a staining agent on the internal surface of the maxillary complete denture and photographed. Results underwent a Kruskal-

Walli test and the Dunn multiple-comparison test. The results are summarised in Table 2.

Cleaning Method	Plaque Remaining (%)
Control	60.9
Chemical	37.2
Mechanical	35.2
Combined	29.1

Table 2: Summarising the level of plaque (%) remaining after using various cleaning methods (Acknowledgement Cruz et al., 2011).

A study by Nishi et al., (2011) involved 96 outpatients of a university hospital's complete dentures who were examined together with 41 nursing home residents. This study evaluated some of the different variables involved in denture hygiene such as age and gender of the subjects but as well as whether they used a denture brush, the amount of time the denture was soaked in the cleanser, the type of product and the frequency of use. To quantify the denture plaque, they swabbed the mucosal surface of the right lateral half of the denture. Correlation was calculated using various mathematical tests such as the chi-square test and the Spearmen rank coefficient as well as other tests similarly to the previous study (Nishi et al., 2011). The results showed that 62.7% of outpatients used a denture brush whereas only 23.5% used a denture brush in the nursing home. 42.9% of outpatients used a denture cleanser daily with a similar percentage in the nursing home at 42.5%. The frequency of use of denture cleanser can be summarised in Table 3.

	Frequency of brushing denture				
	Daily	***5–6 times a week***	***3–4 times a week***	***1–2 times a week***	***Once or less per month***
Outpatients	61(42.9%)	3 (2.1%)	21 (14.8%)	34 (23.9%)	23 (16.2%)
Nursing home residents	34 (42.5%)	0 (0%)	0 (0%)	17 (21.3%)	29 (36.2%)

Table 3: Summarising the frequency of denture cleaning use in outpatients and nursing home residents (Acknowledgement Nishi et al., 2011).

The nursing home residents used two types of alkaline peroxide cleansers although a wider range of different cleansers were used by outpatients. 95.3% and 94.1% of subjects of the outpatients and nursing home residents respectively soaked their dentures over night with the rest soaking for under 30 mins.

Various microorganisms were detected with the most common being *Streptococcus spp. Neisseria spp. and*

Candida spp.

	Outpatients:	Nursing home residents:	Conclusion
Using a denture cleanser regularly reduced the number of microorganisms on dentures.	• Dentures cleaned daily or 3–4 times a week had significantly fewer microorganisms compared to dentures cleaned once or less per week. • Cleaning 5–6 times a week was as effective as cleaning daily. • Dentures cleaned with a denture brush had significantly fewer microorganisms than those cleaned without a denture brush. • Dentures cleaned with a denture brush in outpatients had fewer microorganisms compared to those of nursing home residents using a denture brush.	• Dentures cleaned daily had significantly fewer microorganisms than those cleaned 1–2 times or less per week. • None of the residents cleaned their dentures 3–4 or 5–6 times a week. • No significant difference in microorganisms was observed between those who used a denture brush and those who did not. • When a denture brush was not used, there was no difference in microorganism levels between outpatients and nursing home residents.	• Frequent use of denture cleansers is key to maintaining hygiene and reducing microorganisms. • Using a denture brush helps reduce the number of microorganisms on dentures, especially in outpatients. • Regular use of a denture brush appears more beneficial for outpatients. • Neither the product type nor soaking time of denture cleansers significantly impacted denture cleanliness in either group.

Table 4: Comparison and Summary of Outpatients and Nursing home residents' denture care (Acknowledgement Nishi et al., 2011).

These two studies approached this topic differently to other studies, for example one study researched the effect of the different cleaning methods, mechanical, chemical, ultrasonic and combined and the second study focused on individual variables such as frequency of use and use of denture brush compared to a toothbrush. The multiple variables and directions in these two studies makes analysis somewhat complex to analyse. A study of 60 full denture wearers with a heat-polymerised resin, involved the regulation of the mechanical brushing method which was omitted in the previous study. The brushing stokes per minute; brush and brushing direction were consistent between each participant. An alkaline peroxide solution was used, and variables such as temperature and volume of water were kept constant. The study also examined the efficacy of vinegar as a chemical denture cleaner as well as the alkaline peroxide solution. All results were statistically analysed, however, during the study 10 participants dropped out due to many different reasons therefore only 50 dentures wearers were evaluated in the results. Summarising the results, all the groups had a similar pre-cleansing plaque score with a mean around 15.5. The combination of mechanical cleaning and chemical cleaning with an alkaline peroxide cleaning tablet had the greatest reduction in plaque score followed by the combination of vinegar and brushing which finished marginally above mechanical brushing. The second to last methods was chemical cleaning with alkaline peroxide tablets and finally with the lowest reduction in plaque score was a vinegar solution. These results showed that chemical cleaning resulted in the lowest reductions in plaque scores with the difference in each chemical method being due to their chemical makeup and mechanisms of actions. The combination method was again more effective than mechanical or chemical alone with machinal brushing giving better results in plaque reduction than chemical alone (Yadav et al., 2013) although the study did not evaluate any ultrasonic methodology.

Clinical Implications and Limitations

Denture cleaning methods can have an impact on both oral health and other systemic conditions which can range from side effects to accidental or improper use of specifically chemical denture cleansing tablets. For example, accidental aspiration of denture cleansing tablets can lead to laryngeal oedema as happened to a 78-year-old man accidentally swallowing the tablets even though he imminently spat them out of his mouth (Ochi et al., 2018). A further case of misuse of denture cleaning tablets resulted in the obstruction of the submandibular salivary glands known as obstructive sialadenitis. This injury occurred when someone chewed and swished a denture cleaning tablet around their mouth in attempt to clean a fixed prosthetic bridge (Murdoch-Kinch et al. 1995). The effects of ingesting the tablet also occur. For example, in a questionnaire study, subjects were asked about their experiment of intoxication after ingestion occurred, the results showed that most cases had mild effects however some participants also experiencing major systemic effects. This shows the impact on both oral and systemic health of the improper or accidental use of denture cleansing tablets (Van Zoelen et al., 1998). Other more common effects may also occur such as allergic reactions (e.g., irritation and allergic contact cheilitis) from the use of some denture cleansing tablets such as those that contain persulfates. This happened to a 55-year-old man who was using this cleansing tablet for three years, once he had stopped using the tablet his symptoms cleared. This may be due to the cleansing agent being absorbed onto the pores and tartar on the resin based dental prothesis (Coz and Bezard, 1999). According to Bartlett et al. (2018) the characteristics of an ideal denture cleanser should:

- Demonstrate an effect on biofilm mass
- Deliver substantial stain removal
- Be antibacterial and antifungal, to reduce the level of biofilm harmful pathogens below clinically relevant levels (level to be defined)
- Should be safe to use (non-toxic and compatible with denture materials) and easy to use by patients or caregivers (e.g., in care homes etc)

Damage to Denture Materials:

A downside to these cleaning methods is that they can result in damage to the denture materials. Various studies increasing surface roughness thereby enabling an increase of zones where microorganisms can accumulate which may affect the oral microbiome as mentioned earlier (Žilinskas et al., 2013). This study involved multiple brushing methods e.g. using a soft, medium or hard toothbrush and use of toothpaste which may also contain abrasives depending on the brand. In summary it concluded that toothbrushing e.g., mechanical methods had a negative effect on the denture base material, with harder toothbrushing and abrasive toothpastes having a greater effect on this material. It was also recommended that soft bristle toothbrushes should be used (Žilinskas et al., 2013). Studies on the effect of chemical cleansers on denture materials have also shown that chemicals affect the materials used to make dentures. One study examined the effects of sodium bicarbonate, chlorhexidine and hydrogen peroxide based chemical denture cleansers and showed that all affected the denture materials to varying degrees. According to Ramy et al., (2023) the surface roughness, colour and micro-hardness of each material was also affected.

A review on denture cleanliness by Mylonas et al, (2022) included a table summarising the 'Compatibility of denture cleaning methods with different denture materials' (Table 5).

Denture cleaning method	Acrylic dentures	Metal dentures	Dentures modified with soft or resilient linings	Flexible dentures	Polymer-based dentures
Denture brush			X	X	✓
Toothbrush	✓	✓	X	X	✓
Silicone brush	✓	✓	X	✓	✓
Bleach-based	✓	X	✓	X	✓
Effervescent type	✓	✓	X	X	✓
Mineral-acid-based	✓	X	X	X	✓
Enzyme-based	✓	✓	✓	X	✓
Oral rinses	✓	✓	✓	X	✓
Flexible denture cleaner	✓	✓	✓	✓	✓

Table 5: Compatibility of denture cleaning methods with different denture materials (Acknowledgement Mylonas et al. 2022).

The effect of ultrasonic cleansing methods on a denture appears to have relatively few studies to substantiate it and as such the results are quite mixed depending on whether they combined a chemical cleanser. According to Ates et al., (2016) ultrasonic cleansing negatively affected the surface roughness as did the other cleaning method(s). However, a systematic review completed in 2021 stated that there was no significant effect on surface roughness as well as on the colour of denture materials (Schmutzler et al., (2021). According to a more recent systematic review by Martinez et al. (2024) the combination of brushing and the use of effervescent tablets versus

brushing alone had a significantly higher effect on reducing both the biofilm and bacterial counts with a moderate effect on reducing Candida Species. According to Papadiochou &, Polyzois (2018) the combined application of different hygiene interventions, for example, brushing or ultrasound vibration in conjunction with chemical agents, leads to more effective outcomes (such as reduction in denture biofilm percentage and/or number of micro-organisms' colony-forming units). These authors also concluded that studies evaluating both the colour and dimensional stability of dentures were sparce in the literature. The results from the available studies were also dependent on the concentration of the product and the immersion time of the device.

Discussion and Conclusion

Denture wearers must therefore understand the importance of adequate denture hygiene and the potential oral and systemic effects it can occur when these cleaning methods are inadequate. It is also important that clinicians provide clear instructions on the available multiple cleaning methods which can be both relevant and beneficial to the patient. The patient should also be made aware of the potential risks if the dentures are not well maintained. Several studies, however, have evaluated the knowledge and practices of partial and complete (full) denture wearers (Cakan et al 2015, Shankar et al 2017, Ahmad et al. 2018). The results from both Cakan et al (2015) and Shankar et al (2017) also indicated that between 10.2% and 49% of the patients were advised by dentists on how to take care of their dentures (e.g., cleaning etc). It was also evident from these studies that most patients wore the same denture for more than five years as well as sleeping with their dentures. A review by Papadiochou &, Polyzois (2018) also indicated that denture wearers' attitudes were not complied with the recommended guidelines particularly with both the frequency of hygiene practices and with the continuous wear of the denture (including sleeping with the denture at night). It is therefore imperative that patients should be made aware of the guidelines from the Oral Health Foundation outlining the guidelines for optimal denture care (Table 5).

1. Daily cleaning of the dentures using mechanical action – brushing with a toothbrush or denture brush and an effective, non-abrasive denture cleanser (no dentifrice).

2. Daily soaking in a denture-cleansing solution – this seems to deliver extra chemical breakdown of the remaining plaque and some level of disinfection of the denture. Denture-cleansing solutions should only be used outside the mouth, and denture wearers should strictly follow the manufacturers' guidelines.

3. Denture wearers should not keep their dentures in the mouth overnight, unless there are specific reasons for keeping them in. This guideline is even more important for people at a higher risk of developing stomatitis and for frail or institutionalised older people. Soaking in a denture cleanser solution after mechanical cleaning seems to be beneficial for preventing denture stomatitis and the potential risk of pneumonia events in these groups of people.

4. All patients who wear removable dentures should be enrolled into a regular recall and maintenance programme with their dental professional.

Table 5 Optimal denture care (Acknowledgement Bartlett et al 2018)

The studies included in this review concluded that using any cleaning method is better than no cleaning method at all. Of the available methods, brushing with a suitable denture brush may be the cheapest and quickest way to clean appliances and together with a chemical cleansing tablet also increase the cleaning efficacy. Ultrasonic cleaning may also provide effective cleaning when combined with a cleansing tablet. These devices may also help those patients with limited manual dexterity as they simply need to leave their dentures in the solution. Providing manufacturers' instructions are followed, the potential damage to denture material is minimized however patients should also regularly have their dentures checked every few months to prevent any major damaging occurring. Safety is paramount and all dentures

should be cleaned outside of the mouth to prevent any adverse effects. Overall cleaning dentures can be safe and effective using multiple cleaning methods with combination methods showing the highest-level efficacy although some studies have relatively few subjects with variable methodologies being evaluated. A main inconstancy in these studies was patient adherence and compliance. It is very difficult, especially over long-term studies where the subject is required to participate at home rather being constantly supervised in a clinical setting. Methodology and sample sizes are also limitations in some of these studies. Key variables in this review were: Time spent cleaning, force of brushing, brushing stokes, type of brush, frequency of cleaning and many more. Furthermore, variables such as age and gender can result in different outcomes. For example, older patients may require regular support and instructions to both safely and effectively clean their dentures. Furthermore, on this, developing safe, effective and cost-efficient denture cleanser are key to achieve this aim. There are however differences between those patients in the normal denture wearing population are those in care homes patients' cases and as such it may be advisable for researchers to provide suitable protocols and training for the care workers. One should also be aware that not all cleaning methods are suitable for individual patients and clinician should attempt to recommend a cleaning method relevant to individual's abilities and requirements. Finally, any level of cleansing is better than no cleaning at all and all denture wearers should strive to maintain optimal denture hygiene to promote good oral health and extend the longevity of their denture.

References

1. Adult-oral-health-survey(2021) https://www.gov.uk/government/statistics/adult-oral-health-survey-2021/adult-oral-health-survey-2021-self-reported-health-of-teeth-and-gums accessed 9th May 2025.

2. Ahmad, Salman, Mazhar, Ramsha & Chaudhary, Muhammad. (2018). Influence of demographic variables on denture hygiene knowledge and practices among partial and complete denture wearers. International Journal of Current Research. 10. 65530-65534.

3. Aslanimehr M, Mojarad N, Ranjbar S, Aalaei S. In vitro comparison of the effects of microwave irradiation and chemical and mechanical methods on the disinfection of complete dentures contaminated with Candida albicans. Dent Res J (Isfahan). 2018 Sep-Oct;15(5):340-346. PMID: 30233654; PMCID: PMC6134734.

4. Bartlett D, Carter N, de Baat C, Duyck J, Goffin G, Müller F, Kawai Y. (2018) White Paper on Optimal Care and Maintenance of Full Dentures for Oral and General Health: Global Task Force for Care of Full Dentures, Oral Health Foundation. www.moh.gov.cy/Moh/DS/ds.nsf/All/A63597A180E8C974C225843A002F6620/$file/White paper on optimal care. Accessed 27th March 2025

5. Ates, S.M., Caglar, I., Ozdogan, A. and Duymus, Z.Y. (2016). The effect of denture cleansers on surface roughness and bond strength of a denture base resin. Journal of Adhesion Science and Technology, 31(2), pp.171–181.

doi:https://doi.org/10.1080/01694243.2016.1205273.

6. Cakan U, Yuzbasioglu E, Kurt H, Kara HB, Turunç R, Akbulut A, Aydin KC. Assessment of hygiene habits and attitudes among removable partial denture wearers in a university hospital. Niger J Clin Pract. 2015 Jul-Aug;18(4):511-5. doi: 10.4103/1119-3077.154224. PMID: 25966724.

7. Coz, C.J. and Bezard, M. (1999). Allergic contact cheilitis due to effervescent dental cleanser: combined responsibilities of the allergen persulfate and prosthesis porosity. Contact Dermatitis, 41(5), pp.268–271. doi:https://doi.org/10.1111/j.1600-0536.1999.tb06159.x.

8. Cruz, P.C., Andrade, I.M. de, Peracini, A., Souza-Gugelmin, M.C.M. de, Silva-Lovato, C.H., Souza, R.F. de and Paranhos, H. de F.O. (2011). The

effectiveness of chemical denture cleansers and ultrasonic device in biofilm removal from complete dentures. Journal of Applied Oral Science, 19(6), pp.668–673. doi:https://doi.org/10.1590/s1678-77572011000600021.

9. de Souza RF, de Freitas Oliveira Paranhos H, Lovato da Silva CH, Abu-Naba'a L, Fedorowicz Z, Gurgan CA. Interventions for cleaning dentures in adults. Cochrane Database Syst Rev. 2009 Oct 7;(4):CD007395.

   doi: 10.1002/14651858.CD007395.pub2. PMID: 19821412.

10. Donlan, R.M. (2002). Biofilms: Microbial Life on Surfaces. Emerging Infectious Diseases, 8(9), pp.881–890. doi:https://doi.org/10.3201/eid0809.020063.

11. Martinez Y, Ausina V, Llena C, Montiel JM. Scientific evidence on the efficacy of effervescent tablets for cleaning removable prostheses. A systematic review and meta-analysis. J Prosthet Dent. 2024 Jun;131(6):1071-1083.

    doi: 10.1016/j.prosdent.2023.01.031. Epub 2023 Mar 2. PMID: 36870893.

12. Murdoch-Kinch, C.A., Mallatt, M.E. and Miles, D.A. (1995). Oral mucosal injury caused by denture cleanser tablets. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 80(6), pp.756–758. doi:https://doi.org/10.1016/s1079-2104(05)80262-8.

13. Mylonas, P., Milward, P. and McAndrew, R. (2022). Denture cleanliness and hygiene: an overview. British Dental Journal, [online] 233(1), pp.20–26. doi:https://doi.org/10.1038/s41415-022-4397-1.

14. Nishi, Y., Seto, K., Kamashita, Y., Take, C., Kurono, A. and Nagaoka, E. (2011). Examination of denture-cleaning methods based on the quantity of microorganisms adhering to a denture. Gerodontology, 29(2), pp.e259–e266.

15. doi:https://doi.org/10.1111/j.1741-2358.2011.00461.x.

16. Ochi, N., Yamane, H., Honda, Y. and Takigawa, N. (2018). Accidental aspiration of denture cleanser tablets caused severe mucosal edema in upper airway. The clinical respiratory journal, [online] 12(1), pp.291–294.

    doi:https://doi.org/10.1111/crj.12468.

17. Olms, C., Yahiaoui-Doktor, M., Remmerbach, T. and Stingu, C. (2018). Bacterial Colonization and Tissue Compatibility of Denture Base Resins. Dentistry Journal, 6(2), p.20. doi:https://doi.org/10.3390/dj6020020.

18. Papadiochou S, Polyzois G. Hygiene practices in removable prosthodontics: A systematic review. Int J Dent Hyg. 2018 May;16(2):179-201. doi: 10.1111/idh.12323. Epub 2017 Nov 9. PMID: 29120113.

19. Ramy, Shown, A., Mahmoud Abdellah, Reem Abualsaud and Helal, M.A. (2023). Impact of different chemical denture cleansers on the properties of digitally fabricated denture base resin materials. Journal of Prosthodontics, 33(7), pp.691–699. doi:https://doi.org/10.1111/jopr.13761.

20. Ribeiro DG, Pavarina AC, Dovigo LN, Palomari Spolidorio DM, Giampaolo ET, Vergani CE. Denture disinfection by microwave irradiation: a randomized clinical study. J Dent. 2009;37:666-672 (cited by Papadiochou & Polyzois (2018).

21. Ribeiro DG, Pavarina AC, Dovigo LN, et al. Photodynamic inactivation of microorganisms present on complete dentures. A clinical investigation. Photodynamic disinfection of complete dentures. Lasers Med Sci. 2012;2:161-168 (cited by Papadiochou & Polyzois (2018).

22. Schmutzler, A., Rauch, A., Nitschke, I., Lethaus, B. and Hahnel, S. (2021). Cleaning of removable dental prostheses – a systematic review. Journal of Evidence Based Dental Practice, p.101644. doi:https://doi.org/10.1016/j.jebdp.2021.101644.

23. Shankar T, Gowd S, Suresan V, Mantri S, Saxena S, Mishra P, Panday P. Denture Hygiene Knowledge and Practices among Complete Denture Wearers attending a Postgraduate Dental Institute. J Contemp Dent Pract. 2017 Aug 1;18(8):714-721. doi: 10.5005/jp-journals-

10024-2113. PMID: 28816196.

24. Sharma S, Sharma DS, Palekar U (2013) An in-vitro evaluation of microwave irradiation and denture cleansers on disinfection and destaining of denture base resin, Journal of Pierre Fauchard Academy (India Section), Volume 27, Issue 1, 2013, Pages 32-39, ISSN 0970-2199, https://doi.org/10.1016/j.jpfa.2013.02.002.

25. Sumi, Y., Kagami, H., Ohtsuka, Y., Kakinoki, Y., Haruguchi, Y. and Miyamoto, H. (2003). High correlation between the bacterial species in denture plaque and pharyngeal microflora. Gerodontology, 20(2), pp.84–87.

doi:https://doi.org/10.1111/j.1741-2358.2003.00084.x.

26. Turgut Cankaya, Z., Yurdakos, A. and Gokalp Kalabay, P. (2020). The association between denture care and oral hygiene habits, oral hygiene knowledge and periodontal status of geriatric patients wearing removable partial dentures. European Oral Research, 54(1), pp.9–15.

doi:https://doi.org/10.26650/eor.20200048.

27. Van Zoelen, G.A., De Vries, I. and Meulenbelt, J. (1998). The risks from ingestion of cleaning tablets for dentures and dental prostheses. Nederlands tijdschrift voor geneeskunde, [online] 142(44), pp.2408–11. Available at: https://pubmed.ncbi.nlm.nih.gov/9864537/.

28. Yadav, V., Garg, S., Garg, R., Mittal, S. and Yadav, R. (2013). Effectiveness of different denture cleansing methods on removal of biofilms formed in vivo. Journal of Cranio-Maxillary Diseases, 2(1), p.22. doi:https://doi.org/10.4103/2278-9588.113582.

29. Žilinskas, J., Junevičius, J., Česaitis, K. and Junevičiūtė, G. (2013). The effect of cleaning substances on the surface of denture base material. Medical Science Monitor, 19, pp.1142–1145.doi:https://doi.org/10.12659/msm.889568.