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# HYGIENE PRACTICES IN REMOVABLE PROSTHODONTICS DENTURES

A project submitted to
the Prosthodontics Department/College of Dentistry, University of Baghdad in partial fulfillment of the requirement for a B.D.S. degree

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# Certification of the Supervisor

I certify that this project entitled "**Hygiene Practices in Removable Prosthodontics**" was prepared by **Fahad Ayad** under my supervision at the College of Dentistry/University of Baghdad in partial fulfillment of the graduation requirements for the bachelor's degree in dentistry.

Supervisor's name

**Dr. Yagthan Mohammed Haider**

# Dedication

I dedicate this research to my parents, to my mother who has been giving me support all the time. To my friends for being there for me whenever I needed. To a special person who helped me through all the past years.

# Acknowledgment

My sincere appreciation and gratitude to my supervisor of this research **Dr. Yagthan Mohammed Haider** for all his help.

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| | |
|---|---|
| RPD | Removable Partial Denture |
| CD | Complete Denture |
| DIS | Denture Induced Stomatitis |
| PMMA | Polymethyl Methacrylate |
| SPP | Species |
| AP | Aspiration Pneumonia |

# INTRODUCTION

Tooth loss is a major problem that can cause impaired mastication, phonetic, and esthetic function. The loss of some of the original teeth from the dental arch can be replaced by placing removable partial denture, partial removable denture is an artificial tooth replacing one or more teeth that have been lost and supported by teeth and mucosa that may remove and inserted by the patient. The continuous use of partial dentures and unsaved cleansing of the oral cavity and denture may cause plaque accumulated on both the original tooth directly contacting with the surface of the artificial tooth and the original tooth in the opposite arch. The accumulation of plaque which may be left can lead to caries and inflammation of periodontal tissue leading to excessive alveolar bone pocket and resorption and lesions of the oral mucosa (**Rahmayani et.al. 2020**).

Dentures are an excellent treatment modality for partial and edentate patients; however, improper denture care and hygiene can result in both decreased longevity of the prosthesis and increased risk of developing dental caries, periodontal disease and oral candidiasis (**Mylonas et.al. 2022**).

Prosthodontics function as a reservoir of infection for bacteria and *candida*. Also, an accumulation of plaque, soft debris and calculus seen in
patients with poor denture hygiene care and practices, thus may leading to both oral infection like Denture Induced Stomatitis (DIS) and systemic infections like Aspiration Pneumonia (AP) (**Khalaf et.al. 2015)**.

When a person decides to use artificial teeth, the awareness to keep dental and oral hygiene should not be forgotten. Regular daily denture cleansing should be done to prevent plaque to accumulate and to clean the food debris from the surface. Artificial teeth should be removed from the mouth at night to allow adequate resting of the mouth supporting tissue. Continuous denture wearing may cause some reactions to the tissues because the mucosa beneath the denture will be covered for a long time period, thus blocking the oral mucosal clearance by the tongue and saliva whereby result in the attachment of microorganisms (**Rahmayani et.al. 2020)**.

# AIMS OF THE REVIEW

This review aims to focus on the importance of the hygiene practices among the edentate patients using RPDs and showing the outcome of poor denture hygiene habits and the consequences on oral and systemic health. Also, to review several cleaning methods of the dentures.

# CHAPTER ONE: REVIEW OF LITERATURE

# Chapter one

# Review of literature

## 1.1. DENTURE HYGIENE

Good denture hygiene is important to the wellbeing of patients, and the causes for poor denture hygiene are multi-factorial in nature. It can negatively impact on both oral and general health and the clinical consequences of poor denture hygiene ranging from increased risk of periodontal disease in the partially dentate, to denture stomatitis and oral ulceration **(Parizi et.al. 2013)**.

Life expectancy has increased over the past years, and the number of elderlies requiring dentures has also increased. When an edentulous patient is fitted with a complete or removable partial denture, the important phase of oral and denture care begins **(Parizi et.al. 2013)**.

Since the demand for partial and full dentures is very high and are the only viable solution for those who cannot afford fixed dentures due to very small number of teeth left or for financial reasons, the awareness to keep dental and oral hygiene should be considered with regular daily denture cleansing, storing, disinfection and removing it at night **(Krawczyk et.al. 2015)**.

Several studies have reported statistics related to denture hygiene, emphasizing the importance of proper maintenance to prevent oral infections and improve overall oral health.

One study by **Budtz-Jørgensen et.al. (2020)** found that up to 80% of denture wearers had poor denture hygiene practices, such as irregular cleaning and improper storage. Another study by **Sato et.al. (2020)** reported that 85% of denture wearers did not clean their dentures properly, leading to an increased risk of oral infections.

Moreover, a study by **Singh et.al. (2021)** found that 50% of denture wearers experienced oral thrush and denture stomatitis due to poor denture hygiene practices. Similarly, a study by **Felton et.al. (2021)** reported that up to 65% of denture wearers experienced denture-related problems, such as irritation and soreness.

In contrast, a study by **Kawai et.al. (2019)** found that denture wearers who had regular dental check-ups and cleanings had lower rates of denture-related problems than those who did not. This highlights the importance of regular dental visits for maintaining proper denture hygiene and improving oral health.

Overall, these statistics suggest that there is a need for better education and awareness of proper denture hygiene practices among denture wearers to prevent oral infections and improve overall oral health.

## 1.2. Denture plaque and stain

Denture plaque and stain are common issues that can affect the aesthetics and functionality of dentures. A study by **Nogueira et.al. (2021)** found that denture plaque and stain **(Figure 1)** can lead to bad breath and affect the taste perception of food.

A study by **Fernandes et.al. (2021)** found that denture plaque and stain can be caused by the accumulation of oral bacteria and food debris on the denture surface. To reduce the build-up of plaque and stain, it is important to clean dentures after meals and snacks. In addition, a study by **Ishikawa et.al. (2019)** found that soaking dentures in a mixture of vinegar and water can help remove plaque and stain.

Every surface in the oral cavity, natural or synthetic, becomes covered within about 30 minutes with a 0.5-1.5 μ-thick precipitate of salivary glycoprotein and immunoglobulin that is termed "pellicle" The pellicle in turn provides a substrate to which oral debris (such as mucin, food particles and desquamated epithelial cells) and micro-organisms (bacteria and fungi) readily adhere. Certain adherent bacteria and fungi convert materials such as sucrose and glucose in the oral environment into a protective plaque covering under which they can thrive and proliferate further.

This process is favoured when salivary flow is impaired by disease or, more commonly, as a side effect of medications. In the absence of an adequate amount of saliva, less antimicrobial action will be available to counter the activity and proliferation of microorganisms **(Shay 2000)**.

denture plaque and stain can also be caused by smoking. A study by **Eliades et.al. (2020)** found that denture wearers who smoked had a higher risk of denture stain and discoloration. To prevent these issues, it is recommended to quit smoking.

In addition to affecting oral health, denture plaque and stain can also affect the social and emotional well-being of denture wearers. A study by **Ohyama et.al. (2019)** found that denture wearers who had stained dentures reported lower self-esteem and were more likely to avoid social situations. Overall, regular denture cleaning and maintenance are crucial for preventing plaque and stain and improving the quality of life of denture wearers.

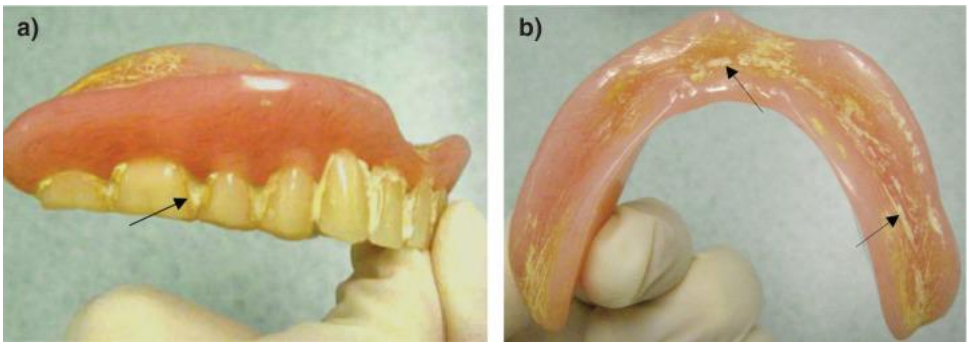



**Figure 1:** Crusting of calculus and plaque on A: maxillary B:mandibular dentures **(Sutula et.al. 2012)**

## 1.3. Denture cleanliness index (DCI)

DCI is done by using plaque disclosing dye and visual inspection Visual inspection: naked eye + magnification (loupes) Scores 0 – 4 with a best score is 0, worst score is 4.

0 – Clean denture. No plaque is visibly seen, no staining, no plaque detectable.

1 – Denture is visibly clean. Little staining (<25% fit surface covered with plaque)

2 – Denture has visible plaque and/or debris. Moderate staining of fit surface (25-50%

fit surface covered in plaque)

3 – Denture has visible plaque and/or debris. Severe staining of fit surface, (>50% fit surface covered in plaque)

4 – Denture has visible calculus deposit, on any surface.

**(Mylonas et.al. 2013)**.

A study was made on Thirty patients wearing acrylic dentures, 9 complete dentures and 21 partial denture wears showed the following:

For 1st audit cycle :


**Figure 2**: Pie chart showing baseline denture hygiene scores for 1st audit cycle **(Mylonas et.al. 2013)**.

For 2nd audit cycle:


**Figure 3**: Pie chart showing baseline denture hygiene scores for 2nd audit cycle **(Mylonas et.al. 2013)**.

## 1.4. Effect of RPD design on plaque retention

According to a study published in the Journal of Prosthodontics, removable partial dentures (RPDs) can increase plaque accumulation due to the presence of a foreign object in the mouth. The study found that patients with RPDs had a significantly higher plaque index compared to those without RPDs. The authors suggest that this increase in plaque accumulation can lead to an increased risk of periodontal disease and dental caries **(Grossmann et.al. 2011)**.

Another study published in the Journal of Dentistry found that the design and fit of RPDs can also affect plaque retention. The study found that RPDs with poorly designed clasps or inadequate retention can cause food debris to accumulate, leading to increased plaque accumulation. On the other hand, RPDs with well-designed clasps and adequate retention can reduce plaque accumulation and improve oral hygiene **(Seligman et.al. 2004)**.

A systematic review published in the Journal of Oral Rehabilitation examined the effect of different RPD materials on plaque retention. The review found that RPDs made of acrylic resin or cobalt-chromium alloy had similar levels of plaque retention. However, RPDs made of gold alloy had significantly lower plaque retention compared to acrylic resin and cobalt-chromium alloy RPDs. The authors suggest that the smooth surface of gold alloys may inhibit plaque accumulation **(Goiato et.al. 2011)**.

## 1.5. Methods of denture cleaning

The major target of all the hygiene interventions in the field of Removable Prosthodontics is to eliminate pathogenic microorganisms counts preventing the reestablishment of a pathogenic biofilm, as well. Denture biofilm removal can be achieved via the application of different types of hygiene practices including mechanical methods, chemical agents and microwave or combination of the aforementioned methods. **(Nalbant et.al. 2008; Boscato et.al. 2009)**.

### 1.5.1. Mechanical hygiene methods

#### 1.5.1.1. Manual mechanical method

**A. Brushing**

A regular toothbrush with soap and water have been previously reported as the most common method of denture cleaning. Proprietary denture brushes and mechanical cleaning adjuncts minimise risk of scratching, which reduces risk of biofilm accumulation and improves clinical longevity of the prostheses. While normal hand washing soap or dishwashing soap has been previously described as a popular method for use together with a denture or toothbrush, they may not provide antimicrobial properties similar to those in specifically formulated chemical denture cleaning agents Adjuncts to assist manual cleaning can be divided into pastes, gels, foams, or powders **(Table 1)**, each have

similar ingredients with similar modes of actions. These are designed to enhance the cleaning capabilities of normal manual cleaning methods.

The choice between the use of a denture brush or a regular soft-bristled toothbrush must be discussed with patients on an individual basis, taking into account patient dexterity, ease of use and access for cleaning their respective denture **(Mylonas et.al. 2022)**.

**Table 1** Manual cleaning adjuncts: denture cleaning gels, foam, Powders and dentifrices **(Mylonas et.al. 2022)**.

| Manual cleaning adjuncts | Common ingredients | Mode of action | Commercial example(s) |
|---|---|---|---|
| Denture cleaning paste ('denture toothpaste') | Water, hydrated silica (abrasive), sorbitol (sweetener), glycerin (humectant), PEG-6 (dispersant), sodium lauryl sulphate (detergent), carrageenan (stabiliser), saccharin sodium (sweetener), CL 42090 (colourant – blue) | Similar to conventional toothpastes but with much finer silica particles, formulated to minimise scratching | Dentu-Crème Denture Cleaning Toothpaste |
| Denture cleaning gel | Citric acid, eucalyptus oil, sea salt | Mildly acidic, antibacterial with some abrasive component | Curaprox Daily Gel Cleaner |
| Denture cleaning foam | Water, glycerin, sesamum indicum (sesame) seed oil, aroma, sorbitol, sodium lauryl sulphate, PEG-40 hydrogenated castor oil, cocamidopropyl betaine, sodium benzoate, PEG-400, benzoic acid, PVM/MA copolymer, sodium saccharin, disodium EDTA, BHT, limonene, linalool | Kills 99.9% of odour-causing bacteria* Low abrasive formula, gentle cleaning action Feel fresh breath for up to five hours | Polident Fresh Cleanse Foaming Cleanser |
| Denture cleaning powder | Potassium monopersulphate (oxidising agent) sodium lauryl sulphate,sodium bicarbonate, citric acid, flavourants | Oxidising formulation, dislodges debris/ biofilm, and antibacterial | Kleenite Denture Cleanser Powder Steradent Denture Cleaning Powder |

**Panzeri et.al. 2009** demonstrated that brushing with two types of pastes (one antibacterial and one with a fluorosurfactant) reduced the biofilm mass when compared with brushing used with water.

Limitations

• Brushing method had no impact on *Candida spp.* colonization, as they appear to be resistant to mechanical debridement from the denture base **(Felton et.al. 2011)**.

• Brushing (with paste) alone is insufficient for reducing the number of microorganisms on dentures biofilms and can only remove large debris **(Nikawa et.al. 1999)**.

• Abration of denture acrylic resin and damage to the surface of soft-lining materials at the result of improper brushing, which creates

roughness, loss of surface lustre and therefore a difficult maintenance of denture hygiene **(Haselden et.al. 1998)**.

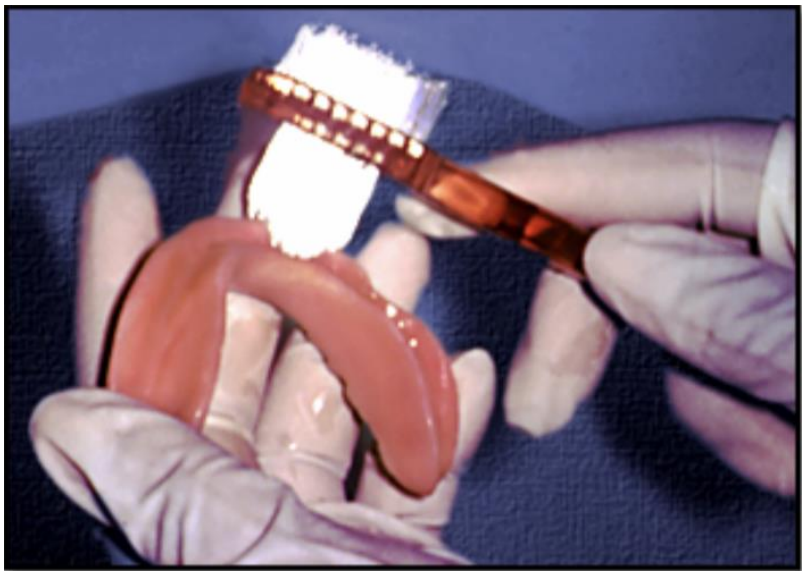


**Figure 4:** Manual cleaning method using a special tooth brush **(Shay 2000)**.

**B. Ultrasonic cleaning**

Ultrasonic treatment is less frequently used due to the lack of both professional and consumer information about this approach and high cost but incomparably more effective mechanical approach of denture cleaning. **(Paranhos et.al. 2007)**.

Ultrasonic cleaning systems function with a typical frequency range between 20–60 kHz. **(Mylonas et.al. 2022)**.

Ultrasound has two action mechanisms, the first being the movement of liquid resulting from sound waves transferred to the liquid (vibration) and the second, the collapse of bubbles formed by vibration of the unit, these (bubbles) in liquid which implode and dislodge

contaminants and food particles from areas of dentures that are difficult to clean **(Pitt & Ross 2003)**.

Dentures that subjected only to ultrasonic vibration in distilled water did not result in remarkable alterations of *C.albicans, Mutans streptococci* or total bacterial counts, it can be assumed that the effect of cavitation bubbles in the aqueous solution is inefficient to diminish the number of the examined microbial species **(Nishi et.al. 2014)**.
Therefore, the effectiveness of the ultrasonic cleaning method is associated with the supplementary chemical action of the immersion solution rather than the mechanical impact only of the ultrasound device (**De Andrade et.al. 2011)**.

**Figure 5:** Ultrasonic denture cleaner **(Tani et.al. 2020)**.

### 1.5.1.2. Chemical methods:

Denture cleaning chemicals are specifically formulated for disinfection of any oral prostheses and must only ever be used extra-orally to prevent harm to the patient **(Shay 2000)**.

They can be categorised according to their chemistry/mode of action:

- Bleach based, and may contain:
    i. Sodium Hypochlorite
    ii. Sodium hydroxide
- Effervescent type, and may contain:
    i. Peroxide
    ii. Bicarbonate
    iii. Percarbonate
    iv. Persulphate
- Mineral acid based
- Enzyme based
- Oral rinses
- Flexible denture cleaners.

### A. Bleach-based denture cleaners

Bleach-based cleaners contain sodium hypochlorite at 1.5% or 2% w/v and/or sodium hydroxide (1.7% w/v) and have the best and broadest antimicrobial capabilities. The antimicrobial action of sodium hypochlorite is attributed to the

hydroxyl (OH-) and chloride (Cl-) ions dissociated in water, which cause the dissolution of microbial cell walls, dissolution of mucins, degradation

of lipids and fatty acids, and irreversible enzymatic inactivation **(Estrela et.al. 2002)**.

They can be used for short duration (typically 10-20 minutes) or overnight disinfection according to manufactures instructions and will vary depending on the dilution ratios specified. A bleach-based denture cleaner consisting of minimum 0.5% hypochlorite solution used for at least three minutes daily was associated with sufficient antimicrobial activity against *Streptococcus mutans* and *Candida albicans*, without changes to acrylic colour, surface roughness or mechanical properties **(De Sousa et.al. 2015)**.

Although the main disadvantage of these cleaners is the risk of acrylic discolouration and degradation of metal-based components, the risk is dependent on concentration and duration of immersion.
**(Kulak-Ozkan et.al. 2002; Salles et.al. 2015)**.

## B. Effervescent type denture cleaners

Effervescent tablets consist of oxidants such as sodium bicarbonate, sodium percarbonate and sodium persulphate, that release carbon dioxide bubbles on dissociation in water, while hydrogen peroxide-containing cleaners release oxygen **(Yildirim-Bicer et.al. 2014; Murata et.al. 2010; Amerlilab 2004)**. Sodium lauryl sulphate is a commonly added detergent to aid biofilm disruption and improve cleaning efficacy of the oxidants present **(Papadiochou & Polyzois 2018)**. While the antimicrobial activity is inferior compared with bleach-based denture cleaners, effervescent-type denture cleaners can be used for cleaning metallic dentures; there have been no reported instances of corrosion from their use **(Oliveira et.al. 2006; Senna et.al. 2011)**. Generally, these cleaners should be avoided in dentures modified with a chairside or laboratory-fabricated acrylic reline material. They degrade these lining materials over time, resulting in

hardening and increasing porosity of the resilient liner **(Amerlilab, 2004; Uludamar 2010 Chittaranjan et.al. 2011)**.

## C. Mineral acid-based denture cleaners

Mineral acid-based cleaners, typically containing hydrochloric or phosphoric acids, are infrequently used in the UK and are more popular internationally. They chemically dissolve any calcified biofilm deposits and the cell membrane of microorganisms in organic biofilms. Extensive tarnishing and corrosion of metallic components will occur if these are utilised with metal alloy-based dentures and their use is therefore contraindicated **(Chittaranjan et.al. 2011; Felipucci et.al. 2011)**.

## D. Enzyme-based denture cleaners:

Enzyme-based cleaners are seldom used in the UK and their composition is similar to effervescent-type cleaners, with the addition of different enzymes, such as lipases, amylases and proteases. They are formulated to degrade fats, glycoproteins and other proteinaceous organic matter, contributing to their antimicrobial activity. They are primarily used with dentures that have had soft reline materials used; there has been limited evidence to show a negative effect on common denture reline materials **(Chittaranjan et.al. 2011; Sorgini et.al. 2012; Rossato et.al. 2011)**.

## E. Oral rinses

Oral rinses encompass any oral care product marketed for use as a mouthwash, with examples including 0.2% chlorhexidine gluconate, 0.05% salicylate solution (a derivative of salicylic acid) and phenolic-based mouthwashes, such as Listerine (Johnson and Johnson, USA). Their use as denture cleaners has been widely reported; however, their antimicrobial properties vary widely.

Chlorhexidine-based mouthwashes (at 0.2% concentration) are the most commonly used oral rinse and recommended for use by oncology patients rehabilitated with oral prostheses **(De Castellucci et.al. 2008)**. Concentrations between 0.2-4% have been demonstrated to provide significant antimicrobial activity, with 4% solution (five-minute soak) providing superior antimicrobial properties against *Candida albicans* and *Streptococcus mutans* on acrylic dentures and dentures with soft silicone linings compared to mechanical brushing and effervescent-type cleaning tablets **(Mantri et.al. 2013)**.

Prolonged use (daily for several months) of chlorhexidine solutions (0.2-4%) can stain dentures in a fashion similar to natural teeth **(Rossato et.al. 2011 & Moffa et.al. 2011; Chittaranjan et.al. 2011 & Sorgini et.al. 2012)**.

Dentures immersed in 2% chlorhexidine solution resulted in perceptible colour changes (brown-like discolouration) after seven days of continuous usage, when compared to dentures soaked in 0.5% sodium hypochlorite solution for three minutes daily for 90 days **(De Sousa et.al. 2015)**. The use of chlorhexidine as a denture cleaner has been demonstrated to provide good antimicrobial and biofilm removal capabilities; however, to minimise the risk of denture staining, its use should be for limited short periods.

## F. Flexible denture cleaners

Flexible dentures are produced thermoplastic polyamide resins, such as nylon and have a limited range of flexible movement. Reported advantages when compared with conventional denture materials (heat-cured PMMA and cobalt-chromium) include increased patient comfort and metal-free construction **(Hundal & Madan 2015)**. These dentures are produced using manufacturer-specific components with companies supplying their own denture-care recommendations. Additionally, a manufacturer's warranty is provided with these denture types, which may be voided if a denture cleaner other than the one recommended by the manufacturer is utilised.

In general, most flexible dentures are cleaned with a specific silicone-bristled denture brush/toothbrush, together with a specified flexible denture cleaner **(Hundal & Madan 2015).** All current flexible denture cleaners have similar formulation and functionality to effervescent-type denture cleaners and typically consist of an oxidant, such as potassium peroxymonopersulphate or potassium peroxydisulphate and acids, such as sodium benzoic acid and citric acid.

### 1.5.1.3. Microwave irradiation

Microwave irradiation use in disinfecting dentures was first suggested in 1985 by Rohrer and Bulard. According to a recent review, this method uses a normal (unmodified) domestic microwave oven to heat a denture immersed in a bowl with tap water; however, there is no agreed nor standardised methodology for their use in cleaning dentures.

Most reported methods immersed dentures under normal tap water before using a microwave oven, with some placing dentures dry in the microwave.

Microwave irradiation has been shown to destroy microorganisms on the surface of denture acrylic, including *Candida albicans* and *Pseudomonas aeruginosa* **(Brondani and Siqueira 2018)**. However, the use of microwave irradiation to disinfect dentures remains contentious and should not be recommended over other simpler and more robust cleaning methods.

### 1.5.1.4. Antibacterial denture wipes

These are a new type of denture cleaning method consisting of a wipe impregnated with an antibacterial cleaning solution. They are designed for discreet cleaning of dentures in situations where the usual mechanical and chemical cleaning methods are either impractical or not possible and their use is therefore complementary to the other conventional denture cleaning methods **(Axe et.al. 2019)**.

**Axe et.al. 2019** determined that denture wipes were well tolerated by participants with no reported issues of oral or dermal reaction and an improvement in both reported quality of life and social confidence.

There have yet to be studies which have assessed the antimicrobial efficacy of these denture wipes compared with standard chemical cleaning methods, such as bleach based or effervescent-type solutions; however, it is known that they provide better antimicrobial activity verses wiping only using, for example, a dry tissue **(Axe et.al. 2019)**.

## 1.6. Complications of unhealthy dentures:

### 1.6.1. Denture stomatitis:

Denture stomatitis, also known as denture-related stomatitis or *Candida*-associated denture stomatitis, is a common inflammatory condition that affects the oral mucosa underneath dentures. It is often caused by the accumulation of *Candida species*, particularly *Candida albicans*, on the surface of dentures due to poor oral hygiene and improper denture care. **(Budtz 1991)**.

Denture stomatitis is a common condition that can affect the oral mucosa underneath dentures. The condition is characterized by inflammation, redness, and swelling of the affected areas, which can be painful and uncomfortable. Denture stomatitis most commonly occurs in the areas of the oral mucosa that are covered by dentures, including the hard palate, the alveolar ridge, and the posterior aspect of the tongue (**Rees 1977)**.

The hard palate is a common site for denture stomatitis due to its constant contact with the denture base. The hard palate is a relatively immobile structure that is covered by a thin layer of keratinized epithelium, making it more susceptible to trauma and inflammation caused by ill-fitting or improperly designed dentures **(Budtz 1991)**. Patients who wear dentures that are poorly fitted or that have been worn for a long period of time are at an increased risk for developing denture stomatitis on the hard palate **(Pacheco 1993)**.

The alveolar ridge is another common site for denture stomatitis, especially in patients with mandibular dentures. The alveolar ridge is a bony structure that supports the teeth and is covered by a thin layer of

mucosa. When teeth are lost, the alveolar ridge can resorb, leading to a decrease in the amount of bony support for the denture. Ill-fitting dentures that do not provide adequate support can cause trauma to the alveolar ridge, leading to inflammation and increased susceptibility to *Candida* infection **(Jeganathan 2005)**.

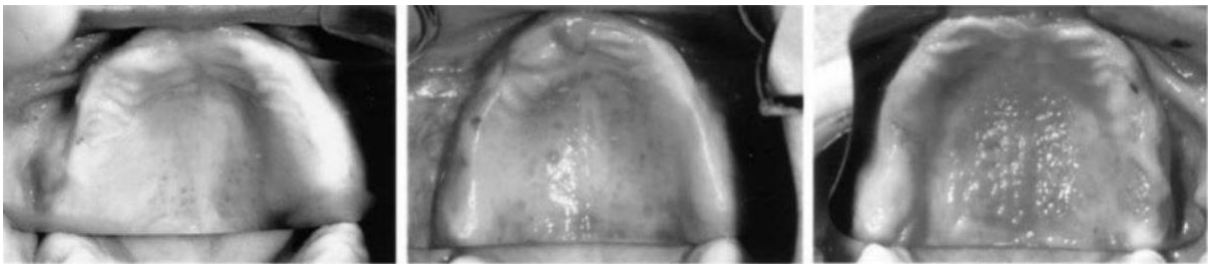
The posterior aspect of the tongue is also a common site for denture stomatitis, especially in patients with full dentures. The tongue is covered by a thick layer of mucosa and is in constant contact with the denture base. This can lead to frictional trauma and increased susceptibility to *Candida* infection. Patients who wear full dentures that do not fit properly are at an increased risk for developing denture stomatitis on the posterior aspect of the tongue **(Felton et.al. 2011)**.

In summary, denture stomatitis is a common condition that can affect the oral mucosa underneath dentures. The condition most commonly occurs in the areas of the oral mucosa that are covered by dentures, including the hard palate, the alveolar ridge, and the posterior aspect of the tongue. Patients who wear dentures that are poorly fitted or that have been worn for a long period of time are at an increased risk for developing denture stomatitis in these areas.

### 1.6.1.1. Classification:

Denture stomatitis presents different degrees of severity classified based on the work of **Newton (1962)** into three types:

- Type1: simple localized inflammation [simple inflammation localized to a limited area-pin point hyperaemia] often trauma indicated.
- Type2: simple diffuse (generalized inflammation) [simple inflammation involving the whole area covered by the denture]
- Type 3: granular inflammation (papillary hyperplasia) [involving the central part of the hard palate and alveolar ridge] both 1and2 associated with denture plaque **(Rangarajan & Padmanabhan 2017)**.



**I** **II** **III**

**Figure 6:** Photographs of palates, depicting Newton types of inflammation **(Barbeau et.al. 2003)**.

### 1.6.1.2. Risk factors:

One of the risk factors for denture stomatitis is poor oral hygiene, including inadequate cleaning of dentures. Denture wearers should be advised to clean their dentures thoroughly on a daily basis using denture cleansers or mild soap and water, and to remove their dentures at night to allow the oral mucosa to rest. Proper denture care and regular cleaning can help prevent the accumulation of *Candida* and reduce the risk of denture stomatitis **(Felton 2011)**.

Another risk factor for denture stomatitis is the ill-fitting or improperly designed dentures. Dentures that do not fit properly can cause trauma to the oral mucosa, leading to inflammation and increased susceptibility to *Candida* infection. Dentists should ensure that dentures are properly fitted and provide regular follow-up to assess the fit and condition of dentures **(Webb 1998)**.

In addition to poor oral hygiene and ill-fitting dentures, other factors that can increase the risk of denture stomatitis include age, dry mouth, systemic diseases such as diabetes, and the use of certain medications, such as corticosteroids and antibiotics **(Budtz 1991; Gendreau 2011)**. Patients with these risk factors should be monitored closely for the development of denture stomatitis and provided with appropriate oral hygiene instructions and denture care recommendations **(Gendreau 2011)**.

### 1.6.1.3. Management:

The management of denture stomatitis involves a multifactorial approach, including improving oral hygiene, proper denture care, and antifungal treatment. Denture wearers should be instructed to clean their dentures thoroughly, remove them at night, and brush their oral mucosa and tongue regularly. Antifungal medications, such as nystatin or fluconazole, may be prescribed to treat *Candida* infection, and dentures should also be soaked in antifungal solutions **(Felton 2011)**. In some cases, denture adjustments or replacement may be necessary to ensure proper fit and reduce trauma to the oral mucosa **(Webb 1998)**.

## 1.6.2. Aspiration pneumonia:

Is a potentially life-threatening infection, especially in the elderly, it may cause death in patients aged 65 years and older, it is a significant cause of morbidity and mortality in patients of all ages. **(O'Donnell et.al. 2016)**.

Is a type of pneumonia that occurs when foreign substances, such as food, drink, or saliva, are inhaled into the lungs, leading to an infection in the respiratory tract. The risk of aspiration pneumonia is higher in individuals with conditions that affect swallowing, such as dysphagia, or weakened cough reflexes, such as in elderly or debilitated individuals **(O'Donnell et.al. 2016)**.

Most cases of bacterial pneumonia are probably initiated following colonization or superinfection of the pharynx by pathogenic bacteria, followed by aspiration of pharyngeal contents. Therefore, pharyngeal bacterial flora may play a key role in the pathogenesis of pneumonia **(Scannapieco 1996)**.

### 1.6.3. Caries & Periodontitis:

Several reports indicated or implied a relationship between *C. albicans* in denture plaque and caries, therefore high risk of caries and progression of periodontal disease often associated with wearing of over-dentures or partial dentures adjacent to the abutment teeth. **(Nikawa et.al. 1998)**.

### 1.6.4. Malodour:

Denture-related malodour is a common concern among patients wearing prosthodontics. A study by **Dos Santos et.al. (2020)** investigated the prevalence of malodour in complete denture wearers and found that 50% of the participants reported experiencing malodour. The malodour was attributed to various factors, including plaque accumulation, food debris, and microbial colonization on the denture surface.

Poor oral hygiene and inadequate denture cleaning practices can contribute to malodour in patients wearing prosthodontics. A study by **Felton et.al. (2018)** investigated the relationship between oral hygiene practices and denture-related malodour and found that patients who did not clean their dentures properly or did not practice good oral hygiene were more likely to experience malodour. The study emphasized the importance of regular denture cleaning and oral hygiene practices to prevent malodour in patients wearing prosthodontics.

Denture-related malodour can also be caused by the presence of *Candida albicans*, a common oral fungal species, on the denture surface. A study by **Ramage et al. (2019)** investigated the role of *Candida albicans* in denture-related malodour and found that the presence of *Candida albicans* on the denture surface was significantly

associated with malodour in denture wearers. Proper denture cleaning techniques and antifungal treatments were suggested as strategies to prevent and manage *Candida albicans*-associated denture malodour.

# CHAPTER TWO: CONCLUSIONS

# Chapter two

## 2.1 Conclusions:

1. Maintaining proper hygiene practices is crucial for patients wearing removable prosthodontics.

2. Denture brushing is the most commonly applied hygiene practice among denture wearers worldwide.

3. proper brushing and disinfection, is essential to prevent biofilm formation and *Candida albicans* colonization.

4. The guidance and explanations done by dentists regarding denture cleansing and wearing habits and the need for periodical visits are an essential step to educate the patient for the correct cleansing and preventing denture staining and other oral and systemic diseases.

5. Incorrect habits, such as wearing complete dentures at night associate with the prevalence of denture stomatitis.

6. Plaque accumulation on the fitting surface of the denture is a major etiologic factor in the pathogenesis of oral infectious diseases.

# References:


## -A-

1. Amerlilab (2004). Effervescent tablets: Key facts about a unique, effective dosage

## -B-

2. Barbeau, J., Séguin, J., Goulet, J. P., de Koninck, L., Avon, S. L., Lalonde, B.,Deslauriers, N. (2003). Reassessing the presence of *Candida albicans* in denture-related stomatitis. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 95(1), 51–59.
3. Boscato N, Radavelli A, Faccio D, Loguercio AD. (2009) Biofilm formation of *Candida albicans* on the surface of a soft denture-lining material. Gerodontology.; 26:210-213.
4. British Society for Disability and Oral Health. Clinical guidelines: The Oral Management of Oncology Patients Requiring Radiotherapy, Chemotherapy and/or Bone Marrow Transplantation. 2018.
5. Budtz-Jørgensen E, Stenderup A, Grabowski M. (1975), An epidemiological study of yeasts in elderly denture wearers. Community Dent Oral Epidemiol. 1975 Jul;3(4):115-9.
6. Budtz-Jorgensen E. (1981), Oral mucosal lesions associated with the wearing of removable dentures. J Oral Pathol.10(2):65-80.

## -C-

7. Chittaranjan B, Taruna M, Sudhir N, Bharath V M. (2011) , Material and methods for cleaning the dentures. Indian J Dent. Adv. 3: 423-426.

**-D-**

8. de Castellucci Barbosa L, Ferreira M R M, de Carvalho Calabrich C F, Viana A C, de Lemos M C L, Lauria R A. (2008) , Edentulous patients' knowledge of dental hygiene and care of prostheses. Gerodontology 25: 99-106.
9. De Sousa Porta S R, de Lucena-Ferreira S C, da Silva W J, Del Bel Cury A A. (2015) , Evaluation of sodium hypochlorite as a denture cleanser: a clinical study. Gerodontology 32: 260-266.
10. Dos Santos, V. E., de Oliveira, T. F., Ribeiro, D. G., & Garcia, R. C. (2020). Malodour in complete denture wearers: A cross-sectional study. Gerodontology, 37(2), 163-169.

**-E-**

11. Eliades, A., Papazoglou, E., Athanasiou, A. E., & Eliades, T. (2020). Influence of tobacco smoking on denture base material discoloration. Journal of Prosthodontic Research, 64(1),68-72.
12. Estrela A, Estrela C R A, Barbin E L, Spanó J C E, Marchesan M A, Pecora J D. (2002) , Mechanism of action of sodium hypochlorite. Braz Dent J 13: 113-117

**-F-**

13. Felipucci D N B, Davi L R, Paranhos H F O, Bezzon O L, Silva R F, Pagnano V O. ( 2011 ) , Effect of different cleansers on the surface of removable partial denture. Braz Dent J 22: 392-397.
14. Felton D, Cooper L, Duqum I, Minsley G, Guckes A, Haug S, Meredith P, Solie C, Avery D, Chandler N. (2011) , Evidence-Based Guidelines for the Care and Maintenance of Complete Dentures: A Publication of the American College of Prosthodontists. J Am Dent Assoc. Aug;142 Suppl 1:1S-20S.

15. Felton, D., Cooper, L., Duqum, I., Minsley, G., & Guckes, A. (2018). Complete arch implant rehabilitation using the “all-on-four” treatment concept: A retrospective study. The Journal of Prosthetic Dentistry, 120(6), 895-900.

16. Fernandes, F. S., Oliveira, A. V., de Almeida, M. L., & Silva-Lovato, C. H. (2021). Causes, consequences and prevention of denture stains and plaque: A systematic review. Journal of Prosthodontic Research, 65(3), 232-240.

**-G-**

17. Gendreau L, Loewy ZG. (2011), Epidemiology and aetiology of denture stomatitis. J Prosthodont. Jun;20(4):251-60. doi:10.1111/j.1532-849X.2011.00698. x. Epub Apr 4. PMID: 21463383.
18. Goiato, M. C., Pesqueira, A. A., Ramos da Silva, C., & Gennari-Filho, H. (2011). Effect of different removable partial denture materials on biofilm accumulation: a systematic review. Journal of oral rehabilitation, 38(11), 862-875
19. Grossmann, Y., Nissan, J., Levin, L., & Schwartz-Arad, D. (2011). The effect of removable partial dentures on plaque accumulation and periodontal health. Journal of prosthodontics, 20(2), 132-137.

**-H-**

20. Haselden CA, Hobkirk JA and Pearson GJ. (1998) Comparison between the wear resistance of three types of denture resin to three different dentifrices. J Oral Rehab 25: 335–339.

**-I-**

21. Ishikawa, Y., Matsumoto, H., Otsuka, Y., Yoshimoto, K., Yoshinari, M., Namba, T., ... & Maeda, N. (2019). In vitro evaluation of the effects of denture cleaning solutions on the color stability of denture base and teeth materials. Dental Materials Journal, 38(3), 401-407.

**-J-**

22. Jeganathan S, Payne AG, Brennan PA. (2005) , Oral candidosis in relation to oral immunity. J Oral Pathol Med.34(6):421-426.

**-K-**

23. Kawai Y, Murakami H, Matsuura M, Kato T, Ogawa T. (2019) , Evaluation of the oral health of elderly complete denture wearers receiving home dental care in Japan: relationships among oral hygiene care, denture plaque, and the oral condition. J Prosthodont Res. Jul;63(3):290-296.
24. Khalaf S., Riath M., Ibrahim A. And Salah H. (2015), Evaluation of the Hygiene Habits of Removable Partial Denture Wearer Patients Visiting The dental Faculty-Universiti Sains Malaysia. World Applied Sciences Journal, 33(9), 1518-1521.
25. Krawczyk, J., Bożyk, A., Kiworkowa-Rączkowska, E., Berger, M., Bakalczuk, M., Szkutnik, J., ... & Sapula, M. (2015). Hygiene, ways of storage and lifetime of removable dentures. Journal of Pre-Clinical and Clinical Research, 9(1).
26. Kulak-Ozkan Y, Kazazoglu E, Arikan a. (2002) , Oral hygiene habits, denture cleanliness, presence of yeasts and stomatitis in elderly people. J Oral Rehabil 29: 300-304.

**-M-**

27. Mantri S S, Parkhedkar R D, Mantri S P. (2013) , *Candida* colonisation and the efficacy of chlorhexidine gluconate on soft silicone-lined dentures of diabetic and non-diabetic patients. Gerodontology 30: 288-295.

28. Moffa E B, Giampaolo E T, Izumida F E, Pavarina A C, Machado A L, Vergani C E. (2011), Colour stability of relined dentures after chemical disinfection. A randomised clinical trial. J Dent
29. Murata H, Chimori H, Hong G, Hamada T, Nikawa H. (2010), Compatibility of tissue conditioners and denture cleansers: influence on surface conditions. Dent Mater J 29: 446-453.
30. Mylonas P, Afzal Z, Attrill DC and Walmsley AD (2013), Denture Hygiene: an audit conducted in general dental practice and a role for the Dental Hygienist and Therapist, School of Dentistry, College of Medical and Dental Sciences, University of Birmingham, Birmingham, B4 6NN.
31. Mylonas P., Milward P. and McAndrew R. (2022), Denture cleanliness and hygiene: an overview, British dental journal, volume 233 NO. 1 20-25

**-N-**

32. Nalbant AD, Kalkanci A, Filiz B, Kustimur S. (2008) Effectiveness of different cleaning agents against the colonization of *Candida spp* and the in vitro detection of the adherence of these yeast cells to denture acrylic surfaces. Yonsei Med J.; 49:647-654.
33. Newton AV. (1962) Denture sore mouth: a possible aetiology. Br Dent J 112:357-60.
34. Nikawa H, Hamada T, Yamashiro H, Kumagai H. (1999) A review of in vitro and in vivo methods to evaluate the efficacy of denture cleansers. Int J Prosthodont 12: 153–159.
35. Nikawa, H., Hamada, T., & Yamamoto, T. (1998). Denture plaque — past and recent concerns. Journal of Dentistry, 26(4), 299–304.
36. Nogueira, S. S. C., de Carvalho, F. G., & Leite, R. S. C. (2021). Denture plaque and staining: Causes, effects and prevention. Journal of Clinical and Experimental Dentistry, 13(1), e95-e101.

**-O-**

37. O'Donnell, Lindsay E., et al. (2016) "Dentures are a reservoir for respiratory pathogens." Journal of Prosthodontics 25.2: 99-104.
38. Ohyama, T., Kanazawa, M., & Sasaki, Y. (2019). Influence of denture plaque on the social and emotional well-being of denture wearers. Journal of Prosthodontic Research, 63(4), 410-414. doi: 10.1016/j.jpor.2019.05.002
39. Oliveira L V, Mesquita M F, Henriques G E P, Consani R L X, Fragoso W S. (2006) , The compatibility of denture cleansers and resilient liners. J Appl Oral Sci 14: 286-290.

**-P-**

40. Pacheco AT, Kiat-amnuay S, Davenport WD. (1993) , Oral mucosal lesions in a selected group of Thai patients with complete dentures. J Prosthet Dent. 69(3):292-295.
41. Papadiochou S, Polyzois G. (2018), Hygiene practices in removable prosthodontics: A systematic review. Int J Dent Hyg 16: 179-201.
42. Paranhos HF, Silva-Lovato CH, Souza RF, Cruz PC, Freitas KM, Peracini A. (2007) Effects of mechanical and chemical methods on denture biofilm accumulation. J Oral Rehabil. 34:606-12.
43. Pitt WG, Ross SA. (2003) Ultrasound increases the rate of bacterial cell growth. Biotechnol Prog 19: 1038– 1044.

**-R-**

44. Rahmayani L, Sofya PA, Andriany P, Jingga CS (2020) , Oral hygiene behavior of acrylic removable partial denture usage community in Seuneubok District, West Aceh: A cross-sectional study. J Int Oral Health 12:163-7.
45. Ramage, G., Tomsett, K., Wickes, B. L., & López-Ribot, J. L. (2019). Denture stomatitis: A role for *Candida* biofilms. Oral Surgery, Oral

Medicine, Oral Pathology, Oral Radiology, and Endodontology, 127(4), 317-324.

46. Rangarajan, V., and T. V. Padmanabhan. (2017) Textbook of Prosthodontics- E Book. Elsevier India.
47. Rees TD. (1977) , The prosthetic oral mucosa: a review of the literature. J Prosthet Dent.38(4):390-399.
48. Rossato M B, Unfer B, May L G, Braun K O. (2011) , Analysis of the effectiveness of different hygiene procedures used in dental prostheses. Oral Heal Prev Dent 9: 221-227.

**-S-**

49. Salles M M, Badaró M M, de Arruda C N F et al. (2015), Antimicrobial activity of complete denture cleanser solutions based on sodium hypochlorite and Ricinus communis - a randomized clinical study. J Appl Oral Sci 23: 637-642
50. Sato K, Akiba N, Kimura Y, Tsukamoto M, Toda T, Yoshihara A, Miyazaki H. (2015), Denture wearing during sleep doubles the risk of pneumonia in very elderly. J Dent Res. Mar;94(3 Suppl):28S-36S. doi: 10.1177/0022034514552493.
51. Seligman, D. A., Pullinger, A. G., & Solnit, G. (2004). The effect of removable partial dentures on plaque accumulation. Journal of dentistry, 32(7), 575-578.
52. Senna P M, Vieira A P C, Sotto-Maior B S, da Silva W J, Del Bel Cury A A. (2011), Influence of immersion time of denture cleansers on the surface roughness of resilient denture liners. Rev Odonto Cienc 26: 35-39.
53. Shay, K. (2000). Denture hygiene: A review and update. Journal of the American Dental Association, 131(4), 524-530. doi: 10.14219
54. Singh A, Verma P, Aggarwal A, Sachdev V, Gupta R. (2016) The prevalence of denture-related stomatitis in a northern Indian population.

Indian J Dent Res. 2016 May-Jun;27(3):292-6. doi: 10.4103/0970-9290.186239.

55. Sorgini D B, da Silva-Lovato C H, de Souza R F, Davi R L, Paranhos H F O.(2012) , Abrasiveness of conventional and specific denture-cleansing dentifrices. Braz Dent J 23: 154-159.

56. Sutula J., Coulthwaite L., Thomas L., and Verran J. (2012), The effect of a commercial probiotic drink on oral microbiota in healthy complete denture wearers, Microbial Ecology in Health & Disease 23: 18404

**-T-**

57. Tani, A., Toyama, T., Inoue, T., Takahashi, K., & KAKIMTO, K. (2020). Sterilization effects of commercial denture cleaners compared with a combination of denture cleaners and ultrasonic Journal of Osaka Dental University, 54(2), 225-238.

58. Torabi Parizi M, Taheri Sh, Amini P, Karimi Afshar M, Karimi Afshar M. (2013), Evaluation of denture hygiene among removable denture wearers referred to clinics of Kerman, Iran. J Oral Health Oral Epidemiol 2(1): 44-8.

**-U-**

59. Uludamar A, Ozkan Y K, Kadir T, Ceyhan I. (2010) , In vivo efficacy of alkaline peroxide tablets and mouthwashes on *Candida albicans* in patients with denture stomatitis. J Appl Oral Sci 18: 291-296.

**-W-**

60. Webb B, Thomas CJ, Harty DWS, Willcox MDP. (1998) Effectiveness of two methods of denture sterilisation. J Oral Rehab 25: 416–23.

**-Y-**

61. Yildirim-Bicer A Z, Peker I, Akca G, Celik I. (2014) , In vitro antifungal evaluation of seven different disinfectants on acrylic resins. Biomed Res Int