



Denture Hygiene in the Context of the Increasing Elderly Population-A Review

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Abstract

March 20th is celebrated as world oral health day, highlighting the importance of oral hygiene. The theme of this year is 'Be proud of your mouth: Oral health'. This review is done to highlight the importance of denture hygiene and maintenance of oral health of the individuals who wear removable complete dentures. Within another three decades, one fifth of the population will be constituted by senior citizens and a sizable number will be denture wearers. By the turn of this century, academics in the dental profession believed that the relevance of complete dentures will reduce but in reality, this has not happened and the need for complete dentures sustained because of the enhanced expectancy of life. Maintenance of denture hygiene and related denture stomatitis caused predominantly by *Candida albicans* do not receive adequate attention at present. Elderly individuals are handicapped with many medical conditions which further limit the oral health status. In this review, different methods of denture cleaning are briefly described. Standard protocols of denture maintenance available in the literature is also included.

Keywords: Denture Hygiene; Chemical Cleaning; Oral Microflora; Oral Health; Denture Stomatitis; Ultrasonic Cleaning; *Candida*

Introduction

Aging population of India will be 20% of the total population by 2050. By 2046, the elderly population will surpass the population of children. These observations are made by the United Nations Population fund in its India aging report of 2023. In the state of Kerala, women of sixty years have a life expectancy of 22 years whereas men have four years less. This fact cautions us to note that a major portion of our population will be constituted by senior citizens [1]. It is estimated that by 2050, 8 in 10 of the older people, above the age of 65 will be living in the Asian region and these people will be constituted mainly by India and China because of the population numbers exceeding billion [2].

Edentulism

Along with the increase in number of older individuals, the disease burden including oral diseases will also increase; especially in the low and middle income sections of the society. The widely quoted statement "Edentulism is a final marker of disease burden

for oral health" focuses on the oral health needs of the society [3]. In a socio demographic evaluation conducted on Indian adults above sixty years found that approximately 16 percent were completely edentulous and sixty percent of dentate individuals were suffering from decayed teeth [4]. Factors associated with edentulism were listed by Peltzer K et al. after evaluating the pooled data obtained from six countries viz. China, India, Ghana, South Africa, Mexico and Russia. The factors related to edentulism, identified were as follows: old age, educational status, presence of non communicable diseases, use of tobacco, inadequacy of vegetable and fruit consumption [5].

Will we continue with complete dentures?

'Will there be a need for complete dentures by 2020' was a question raised at the turn of the century. This was based on the fact that edentulism is declining because of the superior preventive measures and accessibility to high quality treatment facilities. In reality this has not happened because the decline in edentulism

was offset by the increase in adult population. Many academics thought that there is no relevance in continuing with the instructions on complete dentures in dental educational institutions. But in reality, denture wearing is increasing because of the increase in the number of people who depend on removable dentures primarily for mastication [6]. Epidemiological surveys indicate that there is a huge need for complete dentures but there is no data available which provide country wide statistics on the number of denture wearers. Surveys using smaller samples indicate that only ten percent of the needy population gets the complete denture treatment [7]. Many people do not get the treatment because either they are not aware of it or they cannot afford it.

Microorganisms can colonise in different parts of the oral cavity which are vulnerable to plaque accumulation. When a denture is placed, situations get aggravated because of the porous nature

of acrylic resin. Bacteria get removed to some extent when the superficial layers of oral mucosa shed off but with the dentures that is not happening. Dentures harbour different strains of pathogens which are capable of causing local as well as systemic diseases. Respiratory disease-causing pathogens preferentially colonise in dentures especially in high risk patients. Denture hygiene gains importance in this context. Maintaining denture cleanliness avoids denture plaque, calculus, bad odour, staining and the possibility of stomatitis [8,9].

Denture cleanliness index [10]

Medical Devices Regulations Act of the UK Government has categorised dentures as a medical device (Class II a) which is custom made and intended for continued use and made according to the prescription of a dental professional. Denture Cleanliness Index (DCI) followed in UK is a grading of the staining of the tissue surface of the denture (Table 1).

| DCI Score | Denture Cleanliness Index (DCI) | Intervention based on DCI score |
|-----------|--|---|
| 0 | Clean denture. No plaque visible or detectable. No staining | No intervention required. Reinforce current denture hygiene |
| 1 | Denture appears clean. Some areas stained. (< 25% of fitting surface is stained) | Denture hygiene reinforcement |
| 2 | Denture has visible plaque and/or debris. Moderate staining of fitting surface (25-50% of fitting surface stained) | Denture hygiene reinforcement. Provide patient information leaflet. |
| 3 | Denture has visible plaque and/or debris. Severe staining of fitting surface (>50% fitting surface stained) | Denture hygiene reinforcement. Provide patient information leaflet and denture hygiene kit. |
| 4 | Denture has visible calculus deposit, on any surface. | Intervention by clinician to clean the dentures, denture hygiene reinforcement. Provide patient information leaflet and denture hygiene kit |
| * | Visible defects on the denture, in addition to any of the above mentioned. (Defects defined as those which are potentially plaque retentive and which require repair or remake of denture) | Consider denture reline or remake (depending on the severity of defect) |

Table 1: Denture cleanliness index and the intervention suggested.

(Mylonas P, Afzal Z, Attrill D C; A clinical audit of denture cleanliness in general dental practice undertaken in the West Midlands; British Dental Journal, 2014, 217: 231-4)

Ultrasonic cleaning

Many house hold materials have been tried to make the dentures clean. Vinegar, lemon and baking soda were tried after mixing them with water. After 1930, denture cleansers were introduced under different brand name viz. Polident, Efferdent, Renew etc in tablet and powder form [11].

Ultra sound effectively cleans organic and inorganic contaminants deposited on the surface of dentures through cavitation or bubble formation which on collapse generates shock waves and jet formation. The ultrasonic cleaning systems work usually in the frequency of 20 to 60 kHz. 20kHz is almost eliminated now because young individuals can hear the sound. If metallic objects are

cleaned, even at higher frequencies audible sounds can be heard. However, sub microscopic contaminants like finger prints can be eliminated only with 220 kHz. Ultrasonics can reach crevices which are inaccessible to conventional cleaning methods. Small ultrasonic cleaning units are available in Indian market which are used for dentures and jewellery cleaning [12,13] (Figure 1).

Manual methods

Dentures were manually cleaned by most of the patients with soap and cloth or a brush. While cleaning, old aged individuals found it difficult to hold the denture and which ended up in slipping and fracture. Then they were advised to hold the denture above a vessel filled with water. This practice could prevent fractures con-



Figure 1: Ultrasonic cleaner for dentures.

siderably. Large sized denture brushes with detergents were commonly advised by dentists, in order to reduce abrasion induced by tooth pastes on the dentures. Many patients liked tooth brushes and tooth pastes and studies have proved that tooth pastes will not cause abrasive damages to the denture as believed once. Electric tooth brushes will be more effective in cleaning the dentures along with tooth paste. Ordinary soap and tooth brush may not have definite antimicrobial properties which is desirable because most of the denture wearers do have stomatitis caused by candida. Acrylic with the porous nature can have candida harboured on the surface. In order to enhance the cleaning properties of brushes, many adjuncts have been developed like denture cleaning paste, gel, foam and powder. For healthy individuals, tooth paste and brush would serve well. It is expected that Indian manufacturers might be developing exclusive denture pastes in the future [14-16] (Figure 2).



Figure 2: Denture brush.

Photodynamic therapy

Photodynamic therapy (PDT), as the term indicates, is a form of treatment which utilises light sources like Lasers (low level), Light emitting diodes and other different light sources. For PDT the light source should have a wave length of 600-900nm which are safe and can penetrate 1.5-2.5mm when used on tissues.

PDT can be used for denture cleaning because it effectively eliminates micro-organisms through oxidation and subsequent cell death. Photo sensitising agents like hypericin or 1,9-dimethyl methylene blue is applied on the surface and the light irradiation is used to activate it. In cases of denture stomatitis both the oral mucosa and the denture surfaces are subjected to PDT and it controls the infection considerably. Lasers are effective in controlling candida infection but precautions should be taken to avoid hazards to skin and eyes. Experiments have proved that photodynamic therapy is as effective as conventional drug treatment. In other words, it is an effective alternative treatment against viruses, fungi, parasites and bacteria [17-20].

Sodium hypochlorite and other chemicals

Sodium hypochlorite is a popular chemical known for its antimicrobial property. Usually, it is used in concentrations of 0.5%, 1.5% or 2%. The antimicrobial property is because of the hydroxyl and Chloride ions and which cause dissolution of microbial cell walls. Sodium hypochlorite has bleaching property and continuous use at high concentrations can bleach the acrylic prostheses and appliances. A dip for three minutes in 0.5% solution can provide sufficient antimicrobial potency against *Streptococcus mutans* and *Candida albicans* without causing marked changes in colour and surface roughness. Caution should be exercised when prosthesis with metallic components is disinfected because they may get corroded in due course of time [21-22].

Mouth washes

Mouth washes that contain 0.2% Chlorhexidine gluconate and 0.8% Chlorine dioxide have been tried as denture cleansers and found to be very effective in eliminating *Candida albicans*. Mouth washes were sprayed on the tissue surface from a distance of 5cm and allowed to wait for sixty minutes for maximum effectiveness. In patients who are infected with candida can receive oral application as well as denture spraying [23]. In diabetics and oral cancer patients, dentures with resilient liners can be dipped in 4% Chlorhexidine for 5minutes and it would be effective in controlling *Candida* as well as *Streptococcus mutans*. Long term use of Chlorhexidine may deposit brown stains on the dentures [24].

Chemicals that produce effervescence

Sodium perborate monohydrate and Sodium percarbonate are chemicals that can release oxygen bubbles and disrupts dental plaque and the microorganisms. Sodium lauryl-sulphate is also

added because of its detergent action and cleaning. This group of chemicals have limited antimicrobial activity when compared to Sodium hypochlorite. But these can safely be used with metallic components. Effervescent denture cleaners are not recommended with prosthesis with resilient liners because in due course of time, resiliency of the liners get reduced and the liner becomes stiff defeating the very purpose of it. Patients should be cautioned that the effervescent tablets should never be tried in the mouth or swallowed. The manufacturer's instructions should be strictly adhered to. These products are available in India. In some products, enzymes like amylases, lipases and proteases are included which are capable of lysing fats and protein containing organic substances and eliminating candida albicans [25-27] (Figure 3,4).



Figure 3: Effervescent denture cleaner.



Figure 4: Denture cleaning tab in water.

Cleansing flexible dentures

Flexible dentures made in polyamide resins are popular in India because of its aesthetics and comfort. Valplast and Sunflex are two brands which are freely available. Running water and soft brushes are recommended by the manufacturers for cleaning. Other chemicals and pastes are not recommended for fear of scratches. Both these brands have their own cleansing agents viz. Val clean for Valplast and Sun Sparkle for Sunflex. Valplast has linked the warranty

of the denture with the cleaning substance. These products claim to remove adhering stains and micro-organisms [28,29].

Poly Ether Ether Ketone (PEEK)

PEEK was introduced in the 1990s and is widely used in medical and dental fields. PEEK has been modified by incorporating 20% ceramic and it has become a high performance polymer and almost replacing cobalt chromium frame works in prosthodontic treatment. It has a modulus of elasticity of 4GPa and performs similar to bone and hence widely used in orthopaedics. It is generally compatible with all the commonly used denture cleansers. PEEK prostheses get stained by common beverages like coffee and tea. Mouth rinses and smoking can also cause discoloration. For effective cleaning PEEK prostheses can be immersed in sodium hypochlorite, alkaline glutaraldehyde, 4% chlorhexidine or chlorine dioxide solutions, or denture cleansers, such as alkaline peroxides [30]. However, PEEK locator attachments lose their retention with immersion type cleansing solutions. Locator attachments are of four types indicated by four different colors viz. yellow, pink, clear, and violet. Yellow attachments lose retention considerably but violet ones do not lose retention [31].

Denture microflora

Nearly seven hundred bacterial species have been detected in the oral cavity. During the disease process their existence is in imbalance. So far, the major interest was on denture plaque adhering to tooth surface causing dental caries and periodontal disease. In the recent years elderly population increased and correspondingly the number of denture wearers also increased. Increase in age related diseases like diabetes favoured the presence of denture stomatitis in large numbers. Fatma Alzahraa et al. have included a table of microorganisms isolated from denture wearers in their article which is given as table 2 [32].

Denture stomatitis is a common oral mucosal inflammatory disorder and in the context of the increasing number of elderly population, this is going to be a major health burden. It starts with inflammation of the oral mucosa with characteristic erythema of the denture fitting area. The mucosa swells and makes the denture ill-fitting and patients very often avoid chewing food, eventually leading to considerable change in the quality of life. Nearly 15-70 percent of denture wearers are affected by denture stomatitis [33].

When denture is placed in the mouth, it gets a coating with salivary glycoproteins and immunoglobulins which causes adhesion and colonisation of microorganisms. Denture biofilms were observed through scanning electron microscopy and found large quantity of yeast and hyphal cells establishing the role of candida in denture stomatitis. Trauma due to ill-fitting dentures, overnight wearing and poor maintenance of denture hygiene can enhance causation of denture stomatitis. Anaerobic microorganisms in the plaque produce volatile compounds responsible for malodour characteristic of denture wearing [34-36].

| Type of microorganism | Number (%) | Type of microorganism | Number (%) |
|------------------------------|------------|-----------------------------|------------|
| Gram-positive Cocci | 93 (45) | Gram-negative Cocci | 28 (13.5) |
| <i>Streptococcus species</i> | 86 | <i>Veillonella parvula</i> | 23 |
| <i>S. salivarius</i> | 19 | <i>Nisseria spp.</i> | 5 |
| <i>S. mitis</i> | 16 | Gram-negative Rods | 34 (16.5) |
| <i>S. sanguis</i> | 29 | <i>Bacteroides spp.</i> | 14 |
| <i>S. intermedius</i> | 13 | <i>B. denticola</i> | 9 |
| <i>S. mutans</i> | 9 | <i>B. melaninogenicus</i> | 5 |
| <i>S. aureus</i> | 7 | <i>Fusobacterium spp.</i> | 7 |
| Gram-positive Rods | 38 (18.4) | <i>F. necrophorum</i> | 5 |
| <i>Actinomyces species</i> | 17 | <i>F. mortiferum</i> | 2 |
| <i>A. odontolyticus</i> | 14 | <i>E. coli</i> | 3 |
| <i>A. israelii</i> | 3 | <i>K. pneumonia</i> | 3 |
| <i>Lactobacillus spp.</i> | 15 | <i>E.aerogenes</i> | 2 |
| <i>L. fermentum</i> | 11 | <i>Acinitobactr freundi</i> | 1 |
| <i>L. acidophilus</i> | 4 | <i>Ps. florescence</i> | 1 |
| Not identified | 6 | <i>Haemophyllus spp.</i> | 3 |
| <i>Candida</i> | 13 (6.3) | | |
| <i>Candida albicans</i> | 8 | | |
| <i>Candida glabrata</i> | 3 | | |
| <i>Candida tropicalis</i> | 1 | | |

Table 2: Microorganisms isolated from dentures.

(Fatma Alzahraa M. Gomaa and Zeinab H. Helal, Isolation and Identification of Microorganisms Associated with Removable Denture, Egypt. Acad. J. Biolog. Sci., 2(2): 75- 82 (2010).

In order to maintain denture hygiene, patients should be advised not to wear the denture during night and while sleeping. Use of denture cleansing tablets with brushing effectively maintains hygiene. Intermittent cleaning is not very effective in controlling microbial growth. Elderly individuals do have limitations with their medical conditions like dementia and arthritis which may make cleaning regimens ineffective and they need assistance from care givers [37]. Another method of maintaining denture hygiene is to incorporate antimicrobial materials like anti fungal drugs viz. clotrimazole, quaternary ammonium compounds, silver nano particles, zinc oxide nano particles, graphene nano particles and mesoporous silica nano particles with amphotericin in the denture base material. Their therapeutic effectiveness and after effects are still under evaluation [38].

Guidelines for the care and maintenance of complete dentures published by

The American College of Prosthodontists [39].

After evaluating evidences available in the literature, Felton et al have published a unified guideline for complete denture care

- Careful daily removal of the bacterial biofilm present in the oral cavity and on complete dentures is of paramount importance to minimize denture stomatitis and to help contribute to good oral and general health.
- To reduce levels of biofilm and potentially harmful bacteria and fungi, patients who wear dentures should do the following
 - Dentures should be cleaned daily by soaking and brushing with an effective, nonabrasive denture cleanser.
 - Denture cleansers should ONLY be used to clean dentures outside of the mouth.
 - Dentures should always be thoroughly rinsed after soaking and brushing with denture-cleansing solutions prior to reinsertion into the oral cavity. Always follow the product usage instructions.
- Although the evidence is weak, dentures should be cleaned annually by a dentist or dental professional using ultrasonic cleansers to minimize biofilm accumulation over time.
- Dentures should never be placed in boiling water.
- Dentures should not be soaked in sodium hypochlorite bleach, or in products containing sodium hypochlorite, for periods that exceed 10 minutes. Placement of dentures in sodium hypochlorite solutions for periods longer than 10 minutes may damage dentures.
- Dentures should be stored immersed in water after cleaning, when not replaced in the oral cavity, to avoid warping.

- Denture adhesives, when properly used, can improve the retention and stability of dentures and help seal out the accumulation of food particles beneath the dentures, even in well-fitting dentures.
- In a quality-of-life study, patient ratings showed that denture adhesives may improve the denture wearer's perceptions in retention, stability, and quality of life; however, there is insufficient evidence that adhesives improve masticatory function.
- Evidence regarding the effects of denture adhesives on the oral tissues when used for periods longer than 6 months is lacking. Thus, extended use of denture adhesives should not be considered without periodic assessment of denture quality and health of the supporting tissues by a dentist, prosthodontist, or dental professional.
- Improper use of zinc-containing denture adhesives may have adverse systemic effects. Therefore, as a precautionary measure, zinc-containing denture adhesives should be avoided.
- Denture adhesive should only be used in sufficient quantities (three or four pea-sized dollops) on each denture to provide sufficient added retention and stability to the prostheses.
- Denture adhesives should be completely removed from the prosthesis and the oral cavity on a daily basis.
- If increasing amounts of adhesives are required to achieve the same level of denture retention, the patient should see a dentist or dental professional to evaluate the fit and stability of the dentures.
- While existing studies provide conflicting results, it is not recommended that dentures should be worn continuously (24 hours per day) in an effort to reduce or minimize denture stomatitis.
- Patients who wear dentures should be checked annually by the dentist, prosthodontist, or dental professional for maintenance of optimum denture fit and function, for evaluation for oral lesions and bone loss, and for assessment of oral health status."

Discussion

The number of denture wearers increased along with the aging of global population. Dentures require diligent care and cleanliness to prevent or limit complications like candida infections. A healthy mouth ensures comfort and thereby improve the confidence of the denture wearer. On continued wearing, dentures get deposition of food particles, plaque and microorganisms and stains. On the denture oral mucosa interface, microorganisms multiply and cause bad breath and mucosal infections. Denture brushes and detergents were advised for the cleaning of dentures, a few decades ago. Denture wearers were forced to remove the dentures, even when there is inadequate privacy. This adversely affects the self-esteem of most of the senior citizens. In fact, they prefer an ordinary tooth brush with tooth paste for cleaning the denture. Tooth pastes were discouraged for fear of the abrasive-

ness. But invitro studies have established that toothpastes are not as harmful as we think [14]. However, it is strongly recommended that in the night, dentures must be removed and the tissue-denture interface cleaned to ensure denture hygiene [39]. Brush, paste and perborate containing effervescent tablets will be a good combination for healthy maintenance of denture hygiene [23]. Dentures that receive resilient lining can harbour microorganisms like *Candida albicans* and *Streptococcus mutans*, very easily which have to be eradicated by chemicals like Sodium hypochlorite, the efficiency of which is proven beyond doubt. Dentures immersed in Sodium Hypochlorite for long durations beyond 5 minutes might cause unesthetic bleaching of the dentures [21,22]. Oral health and general health have been linked, especially in systemic conditions such as diabetes, respiratory infections, cardiovascular diseases, Rheumatic diseases and osteoporosis and the elderly population is known for its vulnerability. An urgent need in the present times is to educate the elderly people and the care givers on the maintenance of denture and oral hygiene.

Conclusions

Elderly population is increasing very fast and along with that the number of denture wearers. Denture care education must be given to the needy people and along with that denture care products must be made available at subsidised price. Gerodontic clinics have to be established as a public health service and denture care must reach the door step of the elderly. We are not doing any charity to them; it is their right.

Elderly people see their future in us; and we see our future in them.

Author Contributions

Conceptualization-K. Chandrasekharan Nair, Pradeep Dathan, *Review of articles*- K. Chandrasekharan Nair, Pradeep Dathan, Viswanath Gurumurthi; *Initial draft preparation*- Chandrasekharan Nair, Bheemalingeswara Rao *Review and editing*- Pradeep Dathan, K. Chandrasekharan Nair; *Supervision* – Chandrasekharan Nair. All authors have read and agreed to the published version of the manuscript.

Conflict of Interest

The authors have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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Figure Credits

Fig 1. <https://www.ubuy.co.in/product/16EMV5M-sonic-cordless-denture-cleaner-portable-battery-operated->

Fig 2. <https://www.amazon.in/Denture-Toothbrush-Double-Bristle-False/dp/B085C7SW5D>

Fig 3. <https://www.amazon.in/Efferdent-Denture-Cleanser-240-Tablets/dp/B005S6HMRA>

Fig 4. <https://www.everydaycheapskate.com/how-to-clean-with-denture-tablets>