Effect of the microwave irradiation on disinfection and dimensional changes of complete denture lined with soft resilient liner

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In spite of the simultaneous and rapid improvement in maintenance of oral health, tooth loss is still a problem in geriatric population. This has resulted in increased proportion of population using removable complete dentures.

With advancing age the oral mucosa becomes more permeable to noxious agents and more prone to mechanical damage. To alleviate the possibility of discomfort arising from the hard denture base, or the force transfer to oral mucosa, manufacturers have developed soft denture base liners. It has been suggested that the properties of the soft lining materials should be similar to the oral soft tissue that they are covering. (Hayakawa et al., 1994). The viscoelastic properties of the soft liners make them act as shock absorbers and distribute the stresses on the denture-bearing tissues. Also their use gives more patient comfort during the treatment of the atrophic ridge, bone undercuts, bruxism and dentures opposing natural teeth.

Denture plaque is an important factor in stomatitis in patient who wear dentures with or without liners. Cleaning of dentures and removal of plaque are important steps in the maintenance of good oral health. Therefore, denture cleansers have been considered an efficacious aid to prevent denture plaque formation.

Several methods were proposed to clean the denture base and prevent development of denture sore mouth in denture wearers.
Introduction

Denture-cleansing methods are used clinically for the reduction of denture plaque, debris, and stains and these are generally divided into mechanical and chemical cleaning methods. However, it has been reported that mechanical cleaning methods are insufficient for a complete reduction of microorganisms on the denture.

Recently, the use of microwave energy to disinfect dentures has been suggested to overcome the problems associated with chemical disinfection. Microwave irradiation may be used for decontamination of food, microbiologic laboratory materials, dental instruments, contact lenses, household sponges, clinical waste, material used in clinical laboratories and candida-contamination underwear. However, little information is available concerning the efficacy of microwave irradiation on the disinfection of denture base materials.

So the target of this study was to evaluate the effect of microwave irradiation on disinfection and dimensional changes of complete dentures lined with soft resilient liner.
Soft liners

Edentulism is considered a poor health outcome and may compromise the quality of life. The basic objectives of complete denture prosthodontics are the restoration of masticatory function, facial appearance and the maintenance of the patient’s health. The complete denture wearers may complain from masticatory problems, speech and denture hygiene problems. (Roessler, 2003).

However, many epidemiological studies of the edentulous population has shown that most patients with complete dentures have pathologic tissue changes, that require treatment. These changes have a little relation to a patient’s perception of the denture success, and/or the personal oral health status. (Bloem and Razzog, 1982).

Because of the friable nature of the supporting mucosa, areas of force concentration or misfit of the denture base may result in tissue trauma and, or sore spots. As a result of these conditions, patients frequently do not wear dentures because of the discomfort accompanies their use. (Parr and Rueggeberg, 2002).

Resilient denture lining materials are applied to the fitting surface of dentures to achieve a more equal force distribution, to reduce localized pressures and to improve denture retention by engaging undercuts (Kawano et al., 1992, Polyzois and Frangou, 2001).

Soft liners can be defined as soft polymers applied in the form of a thin layer on the tissue-bearing surface of denture base and rest directly on the oral mucosa (O’Brien, 1997). They are formulated specifically to have a low compliance. Thus, through distortion (elastic deformation), they tend to
absorb much of the occlusal forces. The cushioning effect of soft liner has been documented (Kawano et al., 1991). In the unloaded state, these material adept well to the mucosa and provide clinically acceptable retention for the prostheses. (Parr and Rueggeberg, 2002).

**Ideal requirements of the soft liners**

According to Craig and powers, 2002, the desirable properties of the soft liners are: high bond strength to the denture base; dimensional stability of the liner during and after processing; permanent softness or resilience; lower water sorption; color stability; ease of processing and biocompatibility. Since denture liners are in direct contact with oral tissues, they should be non-toxic, non-irritating and incapable of sustaining fungal and bacterial growth. (Anusavic, 1996; Custon, 1997).

The soft liner should also be resistant to imbibing oral fluids or releasing compounds into the saliva. Fluid imbibitions would result in liner discoloration, swelling and increasing the potential growth of the microorganisms. The release of uncured or soluble products would subject the patient to unknown substances of undetermined biologic reactivity. This release also could result in a stiffer, less resilient lining material over time (Parker et al., 1997).

**Classification of lining materials**

The lining materials may be classified according to: its consistency, durability and composition.

McCabe and Walls, 1998, Classified lining materials according to consistency into: Hard reline materials, Tissue conditioners and Soft lining
Review of Literature

materials, which is further divided according to durability into temporary and permanent soft lining materials.

A) According to their consistency, lining materials are classified into:

1. **Hard reline materials:** The hard reline materials are used to provide chair side reline to the dentures. It is supplied as a powder and liquid which are mixed together; it has two types, the liquid in the type 1 material contains methyl-methacrylate monomer, whilst the liquid of the type 2 material contains butyl-methacrylate monomer, both maybe classified as auto-polymerizing resins and will readily polymerize at room or mouth temperature (McCabe and walls, 1998).

2. **Tissue conditioning materials:** The tissue conditioning materials are soft denture liners which may be applied to the fitting surface of a denture. They are composed of a powder containing poly-ethyl-meth-acrylate and a liquid containing an aromatic ester and ethyl-alcohol (up to 30%) mixture. (Craig and Powars, 2002).

3. **Soft lining materials:** The soft lining materials are classified according to durability into; temporary and permanent soft lining materials.

B) According to their durability, lining materials are classified into:

1. **Temporary soft lining material:** The temporary soft lining materials are similar to tissue conditioners but not as soft as tissue conditioners immediately after setting but they retain their softness for longer time, taking up to one or two months to harden. They are used instead of tissue conditioners were it is impossible to replace the conditioner every 2-3 days, also in cases of ill fitting dentures till the construction of a new one and as a
diagnostic aid to ascertain whether the patient would benefit from a permanent soft liner. (McCabe and Walls, 1998).

2. **Permanent soft lining materials:** The permanent soft liners are used for patients who cannot tolerate a hard denture base as in patient with irregular mandibular alveolar ridge covered by a thin and relatively non-resilient mucosa (McCabe and Walls, 1998). Permanent soft lining materials should have some requirements that are more critical than those of tissue conditioners and temporary soft lining materials, as they should function over a much longer period of time. These requirements include; it should be permanently soft, ideally for the life time of the denture. It should also be elastic to give a cushioning effect and prevent distortion during service. In addition, it should adhere to the denture base, be non-toxic, non-irritant, and incapable of sustaining the growth of harmful bacteria or fungi (McCabe and Walls, 1998).

C) **According to their composition, lining materials are classified into:**

1. **Acrylic resin based soft liner** which is available in both auto-polymerizing and heat-curing forms. The acrylic lining materials undergo a more marked loss of cushioning effect over time. (Murata et al., 2000, Murata et al., 2002).

2. **Silicone based soft denture liners** which are either heat cured or cold cured; the cold cured soft liner is either condensation silicon or addition silicon. The addition curing silicones have only recently become available as denture soft lining materials. They are very similar to the equivalent products used for recording impressions. They are supplied in the form of two pastes which are proportioned and mixed using a cartridge / gun.
system. The silicone materials remain permanently soft but the modulus of elasticity value may decrease due to water absorption which may cause problems as bacterial and fungal growth in the soft lining material. (McCabe and Walls, 1998).

**Indications and contraindication of soft liners**

Wright, 1981, mentioned that, using resilient liners for the restoration of congenital or acquired oral defect permits the utilization of the undercuts in the defects, thus improving retention without traumatizing the soft sensitive tissues.

Zarb et al., 2005 enumerated the reasons for relining a denture as followed:

- To alleviate pain resulting from tilting and rocking of ill-fitted denture that will transmit undue pressure causing pain.
- To improve retention and stability; as loss of fitness makes the maintenance of peripheral seal impossible which will greatly impairs retention.
- To improve appearance by Re-orienting the denture antero-posteriorly; as alveolar bone resorption in the mandible result in sinking of the lower denture below the original vertical dimension in order to occlude the teeth which results in over closure and protrusion of the mandible, which in turn leads to undue approximation of the nose and chin.
- To restore the evenness of occlusal pressure; as with any alteration in the fit of the denture, there will be some alterations of the pressure transmitted to the tissue when the teeth are brought into occlusion.
On the other hand, Ortman and Ortman, 1975, enumerated the contraindications for relining as followed:

- When the tissues are altered from the original recorded one in the old dentures.
- When patients are dissatisfied with the original esthetics, it cannot be corrected by relining.
- When the presence of flabby hyperplasic tissue cannot be conditioned to a satisfactory state, it should be corrected by surgery to produce a better foundation.
- When the centric occlusion is out of harmony with centric relation.

The desirable thickness of the soft liners

Kawano et al., 1994, reported that the shock absorbability of soft denture liners is a function of the thickness of the liner, they claimed that no significant difference between 1.2mm and 2.4mm resilient thickness of specimens and that soft denture liner act as damping materials with increase of its thickness. However, Kawano et al, 1997, noticed that a lining material of 2.4mm thickness provided good shock absorption, whatever the material used. After prolonged water immersion the damping effect was increased for all products and this aging also modified the cushioning properties.

McCabe and walls, 1998, mentioned that the cushioning effect of the soft lining material depends on the thickness of the soft material. The greater the thickness , the greater the cushioning effect, a thickness of 2-3 mm is required for adequate cushioning effect, but the hard acrylic resin
base may become more flexible and weakened exposing the denture base to fracture compared to denture constructed only from hard acrylic material.

**Advantages and Disadvantages of soft liners**

Soft denture liners are often used for the management of painful, atrophied mucosa or traumatic ulceration associated with wearing dentures. The soft denture liner provides comfort for the patient and may reduce the residual ridge resorption by reducing the impact force in the load bearing areas in the supporting structures during function. *(Kawano et al., 1994).*

*Kawano et al., 1991; Hosni et al., 1994,* showed that soft denture liners distributed pressure under dentures more evenly during function. The soft lining material is also used to modify the transitional prostheses after the first stage and second stage implant surgery *(Schwartz-Arod and Chaushu, 1997).*

Moreover, *Price et al., 2002,* mentioned that, using resilient liners have several problems associated with their use such as loss of softness, water sorption, the poor tear strength, colonization by candida albicans and adhesion failure between the liner and the denture base. A weak bond between the relining material and denture base material could create potential surface for bacterial growth, promote staining or result in complete delimitation of the reline and denture base resin. *(Kawano et al., 1992; Arena et al., 1993).*

The adherence of micro-organisms to a surface not exposed to the ‘flushing’ action of fluids is a prerequisite to the colonization and development of pathogenesis and infection *(Verran and Maryan, 1997; Glass et al., 2001).* Some authors have shown that the soft lining materials
present a greater retention of candida albicans than the denture acrylic resin and the high values for surface roughness can also enhance adhesion/retention properties (Verran and Maryan, 1997; Radford et al., 1998; Zissis et al., 2000). Although some previous studies showed that the soft lining materials are suitable substrates for the microbial colonization, others reported that they inhibit the yeast growth (Burns et al., 1987; Nikawa et al., 2000).

**Oral Microorganisms and Denture Related Stomatitis**

The oral deposits and microorganisms that adhere to a dental appliance bring about several undesirable effects. First, the adherent material itself is unaesthetic in appearance and unpleasant in terms of tactile sensation, taste, and odor. Because of the process of accommodation that sensory receptors undergo, the person with an unclean denture is likely unaware of the unpleasant smell and taste of the prosthesis, but gustatory experiments have confirmed impairment in taste and smell perception of external stimuli under circumstances of poor denture hygiene (Hyde et al., 1981).

Several studies have shown that denture plaque is essentially similar to dental plaque, being composed mainly of Gram-positive cocci and rods and Gram-negative rods (Theilade and Budtz-Jorgensen, 1988; Harding et al., 1991). Yeasts, in particular Candida albicans, are also found in denture plaque, although they usually represent only a small proportion (<1%) of the total cultivable microorganisms (Douglas and Lamb, 1988, Harding et al., 1991).
In the oral cavity, most of colonizing and infecting microorganisms are found not as single-living cells but rather as complex structured microbial communities, often encapsulated within a matrix of polymeric material, and attached to biotic or abiotic surfaces (Kolenbrander, 2000).

**Denture related stomatitis** is defined as an inflammatory process that mainly involves the palatal mucosa when covered by complete or partial dentures (Jacobsen et al., 2008).

It was described by Newton, as an erythematous reaction that can be focal or diffused; the mucosa may present either a smooth surface or papillary hyperplasia (Arendorf and Walker, 1987).

**Classification of the denture related stomatitis**

**Newton's classification** (1962): It has been most widely used. Newton classified the denture related stomatitis as follows, Pinpoint hyperemic foci, diffuse hyperemia of the denture supporting tissues and papillary hyperplasia. (Arendorf and Walker, 1987).

**Modified Newton's Classification** (2003): The presence of denture related Stomatitis was assessed according to the modified version of Newton's classification. This classification reflects the classic type of inflammation and the extent to which tissues are affected, No Stomatitis, no evidence of palatal inflammation, Stomatitis Newton type I, petechiae dispersed throughout all or any part of palatal mucosa in contact with the denture, Newton type II, macular erythema without hyperplasia and Newton type III, diffuse or generalized erythema with papillary hyperplasia. (Barbeau et al., 2003).
Etiology of denture related stomatitis

The etiology of the denture related stomatitis is considered as multifactorial and could be divided into systemic factors and local factors.

i.  **Systemic factors**

1- **Dietary factors**: Denture Stomatitis patients have been found to have nutritional deficiencies especially in case of vitamin $B_{12}$ and foliate deficiencies. *(Arendorf and Walker, 1987).*

2- **Immuno-suppressant**, immune-suppressed patients are those patients who have received long lasting immune-suppressive therapy. The immune deficiency or the side effects of the medication may increase the intensity of the denture related Stomatitis. The patients with immuno-suppression were more frequently subjected to stomatitis and Candidal infection *(Tylenda et al., 1989 and Golecka et al., 2006).*

3- **Diabetes**: People with uncontrolled type II diabetes mellitus are at increased risk of developing this condition. So are people with weakened immune systems. They are more likely to be affected with denture related stomatitis. *(Fenlon et al., 1998).*

4- **Smoking**: It has been implicated as one of the systemic predisposing factors of the denture related stomatitis. This may be due to the thermal effects on the oral mucosal cells. *(Fenlon et al., 1998).*

5- **Malignancies**: Candida albicans was the predominant organism isolated from the oral swabs of patients with advanced cancers. Therefore malignancies are predisposing to denture related stomatitis and oral candidiasis due to the immune compromised condition of those patients. *(Davies et al., 2006).*