Type of Research: Review

Properties of Denture Liners - A Review

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Abstract

Denture liners are the materials applied to the tissue side of a denture coming in contact with the soft tissue. It cushions the contact of the denture with the tissues. The usage of the denture liners is to alleviate the trauma associated with complete dentures. The failure in adhesion, changes in rough surfaces and hardness are the favourable factors for microbial accumulation and compromise the liner's durability and causes the oral health conditions like denture stomatitis. The adhesion can be improved with the usage of different substances and surface treatments. The changes in the rough surface and hardness can compromise the material's lifespan. This review deals about the properties of adhesion, roughness and hardness of the denture liners.

Keywords: *Denture liners, denture liner adhesion mechanism, surface roughness, sealants application, hardness.*

Introduction

The denture liners have been widely used in the dentistry to shape prostheses surface in contact with the soft tissues in the oral cavity. The failure in adhesion, changes in rough surfaces and hardness are the favourable factors for microbial accumulation and compromise the liner's durability and causes the oral health conditions like denture stomatitis, implant loss, peri-implantitis and osseointegration delay as well as respiratory problems that can interfere with the rehabilitation treatment success and the quality of the life [1]. The silicone based soft dentures doesn't require an external plasticizer to be soft over a long period of time [2]. The silicone based soft dentures are similar to silicone impression materials. It can manage bruxism, chronic soreness etc., The silicone based soft dentures withstands extrusion forces, energy, viscosity, tensile strength and tear strength and room temperatures. The usage of the denture liners are used to alleviate the trauma associated with complete dentures [3]. The long term soft denture lining materials, despite their established clinical efficacy, the use of Long Term Soft Denture Lining materials (LTSDL) has been limited due to the unfavourable effects of the oral environment on some of their mechanical and performance characteristics [4]. The silicone based denture liners are the most commonly used denture liners due to its more stable hardness, absorption and adsorption and solubility than acrylic based denture liners [5]. The silicone based soft dentures are the relining materials that have no odour or no taste and offer a stronger adhesion and exceptional durability than the other denture liners [6].

Most importantly, all of the lining materials exhibit an aging solution which has specific tendency towards discoloration and the available cleansers are not fully effective and can alter the mechanical properties of the denture liners [7]. The denture liners are processed in laboratories (heat polymerized) and dentist offices (self-polymerized) because of their easy and quick application [8]. The term "soft denture liners" refers to a class of resilient materials used to reline denture base surface

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in contact with the occlusal stress bearing oral mucosa. The denture liners are noninvasive and relatively more economical if compared to make a new denture. Patients prefer resilient liners over the hard ones, because they improve comfort [9]. The denture liners can be either that are usually made of polymethacrylate or resilient, in which plasticizers are added to the resin and silicone elastomers. The resilient materials are also classified as short term and long term products [10]. The long term resilient denture liners maintain their resilience for more than 30 days upto 1 years whereas short term liners can be used upto 30 days. The resilient liners are intended to be elastic, absorb energy and act on the cushion effect [11].

There are some disadvantages like presence of surface defects and porosity, residual taste after use, tendency to pick up odours, water uptake, poor adhesion to acrylic resin, proneness to change of color, difficulty to clean and premature hardening due to plasticizers solubilization [12]. The successful relining depends on the bond strength between the liners and the resin base [13]. This lack of bonding leads to debonding, diminishing the procedures longevity and may occur due to an inefficient bond to the denture or low cohesive strength.

The sealants application, surface treatments and physical mechanical changes resulting from disinfection among others, improve adhesiveness, rough surface and maintain the liners initial hardness [14].

DENTURE LINER ADHESION MECHANISM

The aging alters the adhesive properties of the denture base polymers and liners, leading to flaws on the materials. The failure in adhesion causes the rough surfaces, change in hardness and microbial accumulation that compromise the liner's durability [15]. The important factors for the considerations relative to denture liners adhesion are surface roughness, hardness, antimicrobial agents etc., [16]. The bond between the prosthesis and the denture liner begins with the dissolution of resin by solvent, swelling of surface layers and the evaporation of the solvent. The liner monomers diffuse, penetrate the resin pores and form an interpenetrating polymeric network [17]. The larger the surface swelling, the deeper the porous layer and as a consequence, the better the adhesion between the liner and the denture base [18].

The bond strength between the liner and denture base was assessed through primer application, where the layer of the GC resin primer was applied on the polyamide surface, through an adhesive such as bonding agent that is a reline material partner [19]. According to Ohkubo et al, dentures used for an extended period of time are difficult to reline because microorganisms produce methyl mercaptan, which causes liner detachment even after the primer dissolution [20].

Silicone liners are mechanically superior and more durable than resin liners, however they lack Chemical adhesion and adhesive flaws can be associated with the bonding agent. The adhesive failures between liners and prosthesis are increased after 30 days of storage in water, suggesting that their bonding gradually weakens over time [21]. The air abrasion with silica and silanization had failed to improve bond strength of silicone resilient lining to the prosthesis and defects produced by the 30 μm particles were not sufficient for the liner material penetration [22]. Some organic solvents such as the usage of poly methacrylate and ethyl acetate improve silicone liners adhesion to polymethylmethacrylate because they lead to softening and porosities that enhance adhesive penetration. The adhesion can be enhanced by ethyl acetate as a bonding agent [19].

TREATMENTS TO IMPROVE DENTURE LINER'S ADHESION TO THE PROSTHESIS

The treatments to improve denture liner's adhesion to the prosthesis includes the treatment with acetic acid, tribochemical silica coating, polymethylmethacrylate (PMMA) with methyl formate - methyl acetate (MF-MA) and application of laser [23]. A study showed an increase in silicone based liners bond strength to urethane dimethacrylate base following laser application. The oxygen plasma treatment would improve the tensile bond strength between silicone based soft liner and thermocycler denture base [24]. The plasma is a partially or wholly ionized gas that contains highly reactive particles including electronically excited electrons, sonic and free radical species and photons in the short wave UV range. The plasma treatment is a gentle method to change the characteristics of the topmost layer of the polymer [25]. Mechanical surface preparation of denture base with lasers or alumina abrading had no significant effects on the bond strength compared to untreated

acrylic interfaces [26]. Considering experimental urethane acrylate oligomers-based photopolymerized soft liners, no significant difference in adhesion was observed after 1 day or 12 months of storage in water at 37℃ [27].

LINER'S ADHESION TO DIFFERENT TYPES OF PROSTHESIS

To improve the bonding between polyamide prosthesis and self polymerizable resin liner is by treatment with tribochemical silica and 4-methacryloxyethyl trimellitate anhydride in methylmethacrylate initiated by tri-n-butyl borane (4-META / MMA-TBB) resin [28]. Polyamides can be chemical resistant materials due to their high degree of crystallinity. A study showed that the flaws in the liners adhesion to UDMA prosthesis due to its highly reticular nature that hinders the monomer penetration [15].

The adhesion of hardliners to thermoplastic acrylic resin is similar to that of conventional thermal polymerized acrylic resin. But its results were different from polyamide, since they are chemically resistant [29]. The weak adhesion between the resilient resin base liners and prosthesis is explained by the absence of monomers associated with the non reticulated amorphous polymers. The glass fibers reinforced PMMA showed increased adhesion to the liners since the fibers were previously filled with non reticulated polymers containing PMMA in micrometric scale [19].

SURFACE ROUGHNESS

There are several methods to remove contaminants from the liners. But it is important to assess their effects on the surface since the cleaning solutions penetrate the resin which can change the morphology and the immersion time and concentration can alter the polymer structure [30]. The self polymerizable hard liner's roughness can be increased by the immersion of hard liners in sodium perborate and exposure of radiation with microwaves due to the immersion temperature and oxygen released by the perborate from the sodium perborate [31]. Bubbling from the oxygen release is a mechanical cleaning mechanism [32]. A study found that decrease in roughness is related with the brushing and disinfection with sodium perborate and chlorhexidine gluconate and related it to crosslinked agents that decrease the acrylic resin solubility in the organic solvents [30].

The results of one heat polymerized denture based acrylic resin and another auto polymerized reline resin with cleaning agent resulted in no changes in roughness which was associated with short immersion time [33]. There is an increase in roughness of hard liners because of the porosities that are formed due to the release of residual monomers and plasticizers and from the increase in the temperature during disinfection with microwaves [34]. There is an increase in the roughness when organic solvents such as MMA were applied on PMMA as an attempt to improve the adhesiveness to the silicone based liners because these solvents degrade the surface of the silicone based liners and alter its morphology.

SEALANTS APPLICATION FOR SURFACE ROUGHNESS

The surface sealant application reduces the roughness produced by brushing in silicone and resin based liners, with a more definite effect for siloxane-based material. But it showed no reduction in the roughness even after a sealant was applied to silicone based and methacrylate based liners [14]. There are several situations that increase a liner's roughness, which is a favouring factor for bacteria accumulation. The surface sealants protect the liners against water absorption and damage from substances like chemicals, saliva, food and brushing and coating defects and also reduces porosities and fissures [35]. But there is still no consensus on whether roughness is reduced or not when a surface sealant is applied to the liner.

HARDNESS

According to the specific ISO standards, liners can be classified into type A (soft) and type B (extra soft) from the measurement taken 24 hours after preparation of specimens [36]. A study says that resilient liners compromise changes in hardness over time [37]. Generally, hardness can be defined as the penetration resistance and it is increased in resin liners that are subjected to warm water bathe following polymerization and it is associated with reduction in residual monomers. The hardness of experimental photopolymerizable soft liners based on urethane acrylate oligomers was almost similar to silicone or acrylic resistant liners [27]. Cazacu et al, found that higher hardness values for a

thermostable silicone tested as liner, equivalent to that of addition silicone changes in hardness can also be caused by temperature fluctuation in the oral cavity and due to changes in pH [38]. Immersion in different solutions increased the liner's hardness. But Rezende-Pinto et al found that the reduction in the self-polymerizable hard liner's hardness regardless of the chemical solution or with water immersion [9].

The change in the hardness of the acrylic resilient liners occurred after 1 month of use by patients and smoking patients resulted in higher hardness value, which is probably due to the heat exposure [39]. The frequent use of cleaners kept the liners soft and also delayed their hardening process. the increase in acidity of the saliva was associated with an increased hardness, but this association cannot be generalized [1]. Thus the maintenance of materials hardness is critical for their longevity. It should be noted that the hardness has a direct relation with the viscoelastic properties which are responsible for distributing and tension generated during its clinical function [40]. Sealant application on resilient methacrylate can be effective in preserving hardness [41]. The higher the hardness value, lower the materials ability to absorb the impact of mastication. Decrease in hardness values may sometimes lead to superficial changes and retention of the oral pathogens.

GENERAL CONSIDERATIONS

The failure of adhesion between the prosthesis and liner will compromise the procedure durability and favours microbial colonization and stomatitis [42]. The adhesive failure is associated with the bonding agent. The use of solvents on silicone based liners improve adhesion on the PMMA base [43]. Surface treatments like with acetic acid or with tribochemical silica are required to adhere liners to polyamide denture bases [44]. It is important to preserve the hardness value of the liners so that the liners can maintain its elasticity for a long period of time. The selection of liner should be based on the procedure's objective, considering the serviceability and expected results from the considerations [45].

Conclusion

The diversity of methods presented the properties in a diverse manner, showing that subsequent studies are necessary to meet better utilization and indication of liners regarding hardness, roughness, and adhesion. Based on the present results, further in vivo investigations with randomized controlled trials are necessary to compare the performance and properties of these denture liners' modifications in clinical use. The adhesion to the prosthesis base is improved with treatments like those with acetic acid etc.,. The use of solvents seems to improve the adhesion of the reliners to the PMMA base. Most of the cleansing agents compromise the hardness and elastic modulus. Changes in roughness can lead to the formation of microbial colonization, increase the risk of oral and systemic infections and decrease the quality and life of the dentures. Among the various disinfection methods, minor changes in the hardness and roughness properties of the denture liners were observed when incorporating antimicrobial agents into the liners. Unlike acrylic based long term soft denture liners (ALTSDL) , the viscoelastic properties of silicone based long term soft denture liners materials (SLTSDL) are more appropriate and stable over time. Contrary to ALTSDL, the hardness of SLTSDL is stable over time. The sorption and solubility of SLTSDL is significantly lower than ALTSDL.

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