Considerations in the Application and Benefits of Soft Lining Materials

Selection of soft lining materials to support removable prosthodontic therapy influences treatment success by helping to condition edentulous soft tissues prior to complete or partial denture fabrication. Following surgical interventions (e.g., dental implant placement or preprosthetic tori reduction), liners may be used to control prosthetic force application and improve prosthesis fit against the surgically manipulated denture foundation. Soft liners can also facilitate intraoral drug delivery, although adhesion to denture bases, microorganism colonization and liner cleansability remain concerns. This issue of Prosthodontics Newsletter presents new materials and novel applications of soft lining materials.

Evaluation of Surface Treatments for Adhesion

Denture liners can be classified as either acrylic polymers, such as poly(methyl methacrylate) (PMMA) and poly(ethyl methacrylate), or elastomeric polymers, known as silicone. While silicone-based denture liners are resistant to temperature change and have low degradation rates and high tear strengths, they do not adhere well to PMMA-based denture materials.

To evaluate the effect of different PMMA surface treatments on adhesion of silicone-based denture liners, Cavalcanti et al from the State University of Campinas, Brazil, conducted an in vitro blind analysis of different surface treatment protocols for PMMA resins. They prepared PMMA specimens and divided them into 4 groups:

- no treatment, the control group
- application of methyl methacrylate (MMA) monomer for 180 seconds
- application of an acetone (AC) solution for 30 seconds
- application of an ethyl acetate (EA) solution for 60 seconds

PMMA disks and surface free energy PMMA bars were evaluated for surface roughness. Surface roughness was found to be significant.
Evaluation of Surface Treatments For Adhesion

(continued from front page)

Effect of Denture Cleaners on Soft Lining Materials

Since the 1950s, practitioners have used soft lining materials to increase comfort for denture wearers. These soft lining materials, which can be divided into acrylic and silicone types, form an elastic layer on the area of the denture that comes in contact with the oral mucosa. Because soft lining materials have the propensity to allow colonization by microorganisms, patients are instructed to carry out regular cleansing procedures. However, disinfecting solutions can lead to deterioration of the soft lining materials.

To provide information on the durability of 4 commonly used soft lining materials, Brożek et al from Poznan University of Medical Sciences, Poland, studied the effects of 4 disinfectants and a saliva solution on the properties of the soft lining materials. The authors studied the following 4 materials:

- Vertex Soft (Vertex-Dental B.V.)
- Villacryl Soft (Zhermack SpA)
- Molloplast B (Detax)
- Mollosil (Detax)

The samples were cured according to manufacturers’ instructions. To imitate the various modes of practical use by patients, each material was immersed once daily for 15 minutes in 1 of the following disinfectants:

- 2% aqueous chlorhexidine gluconate
- 2% aqueous sodium hypochlorite
- Corega Tabs cleansing solution
- 3% aqueous hydrogen peroxide

A sample of each material was also exposed to saliva. Samples were stored at either 37°C in an artificial saliva solution for the duration of the study or 37°C for 16 hours daily and at room temperature for the remaining 8 hours. Physical properties were measured by Young’s longitudinal elastic modulus. To measure chemical properties, gas chromatography with mass spectroscopy characterization was employed to determine substances released from the soft lining materials.

While silicone materials showed no deterioration in elastic properties, acrylic elastomers were sensitive to disinfecting solutions. Villacryl Soft showed the greatest change in elasticity when treated with sodium hypochlorite, and Vertex Soft, which had a lower initial elasticity, showed a similar change. Chemical analysis also revealed the silicone materials to be more stable than the acrylic materials.

Comment

The authors found that strong disinfecting substances led to a reduction in the elasticity of soft liners, while liners stored dry or in artificial saliva showed little or no change. Silicone materials were less affected by disinfectants than were acrylic materials.


Microorganism Inhibition on Soft Lining Materials

While soft lining materials reduce the traumatic effects of dentures in certain patients, some studies have found them to be a suitable substrate for microbial colonization, while others report they inhibit yeast growth. Because these organisms can be responsible for oral and systemic infections, Pavan et al from São Paulo State University, Brazil, evaluated the adhesion of pathogenic microorganisms *Staphylococcus aureus* and *Pseudomonas aeruginosa* and the yeast *Candida albicans* to 2 soft lining materials. They also studied the inhibitory effect of these materials on microorganisms and any correlation to surface roughness.

The soft lining materials studied were Molloplast B (Detax GmbH & Co.) and Ufi Gel P (VOCO GmbH). Cultures of *S aureus*, *P aeruginosa* and *C albicans* were used to inoculate 20 mL of Mueller Hinton agar, and prepared specimens of the lining materials were placed in each agar plate. Filter paper discs soaked with 0.05% chlorhexidine gluconate solution served as controls. Colony-forming units per milliliter (CFU/mL) and surface roughness were calculated; significance was defined as \( p < .05 \).

For Molloplast B, the mean number of adhesion cells of *S aureus* and *P aeruginosa* were significantly greater than those of *C albicans*. For Ufi Gel P, *S aureus* showed a significantly greater adherence than did the other microorganisms studied (Figure 1). While Ufi Gel P demonstrated a greater adherence of *C albicans* than did Molloplast B, no significant correlation was observed between the adherence of microorganisms and the surface roughness of the soft lining materials. A visual examination found neither of the materials exhibited a zone of inhibition when compared with the control.

**Comment**

The authors of this in vitro study found that while *S aureus* and *P aeruginosa* adhered more to the soft lining materials tested than did *C albicans*, neither material had an inhibitory effect on the growth of any of the microorganisms. These findings are important because pathogenic bacteria may play a role in denture stomatitis and systemic infections. To substantiate the data, these studies should be conducted again.


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Candida Colonization of Soft Liners in Patients with Diabetes

For patients with diabetes mellitus, soft liners are often more comfortable than conventional prostheses fabricated from hard acrylic resin, but their surface texture, water absorption and diffusion of nutrient material make them prone to microbial adhesion. This can lead to denture stomatitis, caused primarily by *Candida albicans* and related species.

To assess the prevalence of *Candida* species on a heat-polymerized soft silicone lining material, Mantri et al from Hitkarini Dental College & Hospital, India, compared *Candida* growth in 15 patients with noninsulin-dependent diabetes and in 15 patients without diabetes. The authors also examined the antifungal action of 4% chlorhexidine gluconate.

In patients who used soapy water and a soft denture-cleaning brush to clean their dentures, *Candida* colonization at 21 and 30 days was significantly higher in patients with diabetes than in patients without. Immersing the dentures in chlorhexidine gluconate significantly decreased the colonies at 21 and 30 days (Table 1).

This study confirmed previous reports that soft liners used on prosthetics in patients with diabetes can lead to a significant increase in the density of *Candida* colonization. Proper oral hygiene with...
antimicrobial agents can minimize fungal/microbial colonization of soft liners. In this study, soaking the dentures in chlorhexidine gluconate for 5 minutes was found to be more effective at eliminating Candida species than was brushing.

**Comment**

Ensuring that dentures are free of antimicrobial contamination not only controls odors but also maintains oral and systemic health. Further research on the effects of long-term use of chlorhexidine on soft liners is needed.


**Effectiveness of Chlorhexidine In Denture Soft Lining Materials**

With previous studies showing the effectiveness of chlorhexidine solution to suppress the adhesion of Candida albicans to prostheses, researchers have investigated creating a drug delivery system that incorporates antifungal or antimicrobial agents with denture acrylic resin or soft lining materials. Bertolini et al from State University of Rio de Janeiro, Brazil, conducted an in vitro study that evaluated the growth inhibition of C albicans and the rate of chlorhexidine released from resins-based denture soft lining materials modified by chlorhexidine diacetate (CDA) or chlorhexidine hydrochloride (CHC), as well as any change in Shore A hardness. The authors tested 2 denture materials and 2 chlorhexidine solutions:

- poly(methyl methacrylate) (PMMA)
- poly(ethyl methacrylate) (PEMA)
- CDA salt hydrate
- CHC salt hydrate

Antifungal activity against C albicans was evaluated, and drug release was analyzed by the change in optical density of the storage solution by ultraviolet spectrometry. Shore A hardness was evaluated at baseline and after 2 and 7 days of water storage at 37°C. CDA, but not CHC, was released from the PEMA and PMMA soft lining materials in proportion to concentrations of CDA. Shore A hardness increased over time.

**Comment**

Incorporating antimicrobial agents into resins-based denture soft lining materials could create a drug delivery system that would interfere with the colonization and penetration by C albicans. Such a system would be convenient for patients. This in vitro study provided data that could be used for a future in vivo study of a denture soft lining material containing CDA.


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**Table 1. Mean ± standard deviation of Candida growth (colony-forming units/0.2 mL)**

<table>
<thead>
<tr>
<th></th>
<th>Oral flora</th>
<th>15 days soap</th>
<th>21 days soap</th>
<th>30 days soap</th>
<th>15 days chlorhexidine</th>
<th>21 days chlorhexidine</th>
<th>30 days chlorhexidine</th>
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<td><strong>Nondiabetic patients</strong></td>
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<td></td>
<td>0.40 ± 0.61</td>
<td>1.86 ± 1.09</td>
<td>2.26 ± 1.24</td>
<td>2.53 ± 1.31</td>
<td>1.66 ± 1.30</td>
<td>1.20 ± 0.91</td>
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<tr>
<td><strong>Diabetic patients</strong></td>
<td>0.46 ± 0.61</td>
<td>2.46 ± 1.31</td>
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<td>2.20 ± 0.83</td>
<td>1.66 ± 1.01</td>
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**In the Next Issue**

Etiology and diagnosis of temporomandibular stability and dysfunction

Our next report features a discussion of these issues and the studies that analyze them, as well as other articles exploring topics of vital interest to you as a practitioner.

Do you or your staff have any questions or comments about Prosthodontics Newsletter? Please write or call our office. We would be happy to hear from you.

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