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By Joseph J. Massad, DDS; Russell A. Wicks, DDS, MS; Swati A. Ahuja, BDS, MDS; David R. Cagna, DMD, MS

Comparison of Properties of Long-Term Resilient Lining Materials to an Ideal Material

Abstract

A new advancement in long-term resilient liners is the reintroduction of Novus, a polyphosphazene material. Novus (White Square Chemical, Inc.) has excellent shock absorption, bonds well to the prostheses and is free of plasticizers. This article provides a comparison of the properties of the polyphosphazene-based resilient lining material and silicone based resilient lining material to an ideal resilient lining material.

Denture-bearing soft tissues are located between the hard denture base and the jaw bone.[1] Masticatory forces transmitted to the denture bearing mucosa through a hard denture base may cause injury to the mucosa, resulting in sore spots, masticatory pain and further resorption of alveolar bone.[1] Tissue injury and soreness are often attributed to thin and non-resilient oral mucosa and/or severe alveolar resorption. Diabetes, debilitating diseases, heavy bruxing or clenching habits, and old age are predisposing factors for soreness and patient discomfort.[1, 2] Resilient denture liners are widely used for denture wearers who complain of chronic soreness.[1] Resilient lining materials are used to absorb shock and improve the distribution of functional and nonfunctional stresses on the denture bearing tissues.[3] Resilient denture liners are very effective, they enhance prostheses retention, masticatory efficiency and patient comfort.[4-7] In addition, a recent study by Babu et al. has concluded that the use of resilient denture liner significantly reduced the residual ridge resorption in denture wearers compared to complete denture wearers without a liner over a period of one year.[8]

Commercially available resilient liners are classified into two major categories: Polyethyl/methyl methacrylate polymers and silicone polymers.[9] Poly methacrylate copolymers are blended with alcohol and phthalate esters (plasticizers) to lower the glass transition temperature (Tg) producing a more resilient material.[10] Leaching out of plasticizers leads to loss of resilience and material failure, which is the major drawback of these materials.[11-13] Silicone liners retain their resilience for a greater period of time compared to the methacrylate liners, but they have been reported to lose adhesion to the denture base and support fungal growth following 6-12 months of use.[14-17]

Almost all patients tolerate and accept resilient liners. The majority of affected patients prefer resilient denture lining to conventional acrylic dentures.[18] However, the current materials have to be considered as temporary replacements due to loss of resilience and adhesion, increased solubility and water sorption, support of bacterial and fungal growth and color change requiring frequent replacements of the material.[18] A new advancement in long-term resilient liners is the reintroduction of Novus, a polyphosphazene material. Novus (White Square Chemical, Inc.) has excellent shock absorption, bonds well to the prostheses and is free of plasticizers.[19] It is resilient, durable, easy to clean and adjust, readily wettable and resists surface and subsurface fungal and bacterial growth.[20] It is also radiopaque and has an unlimited shelf life if frozen.[21] The polyphosphazene-based liner is introduced into the prostheses (as per the manufacturer's recommendations) through the conventional compression molding procedure.[22] The reformed base has the same longevity as the original denture base.

Molloplast B (Detax GmbH & Co. KG) has been considered as a definitive silicone-based heat-polymerized lining material. It would be interesting to compare the polyphosphazene based resilient liner and the silicone-based heat-polymerized liner to an ideal resilient liner[23] as seen in **Table 1** and **Figures 1 a-d**.

Conclusion

Resilient denture liners are not recommended for patients who adjust well to dentures. However, it is expected that the number of patients requiring

COMPARISON OF AN IDEAL RESILIENT LINER WITH POLYPHOSPHAZENE-BASED LINER AND SILICONE-BASED HEAT-POLYMERIZED LINER

Table 1	IDEAL RESILIENT LINER	POLYPHOSPHAZENE-BASED LINER	SILICONE-BASED HEAT-POLYMERIZED LINER
Shore hardness	20-25 units	45 units[19]	42.28 units[24]
Bond strength	Excellent Bond strength	Excellent bond strength from 16.7-17.6 kg/cm2; Bonded Novus at 26.1 kg/cm2 has an increased bond strength[25]	Excellent bond strength from 16.7 to 17.6 kg/cm2 [25]
Shock Absorption	Excellent	Excellent [20]	Lesser than Novus[20]
Adherence to denture base	Yes	Yes [20]	Requires an adhesive[26]
Resistance to fungal growth	Yes	Yes[27-29]	31 % failures due to fungal colonization at 1 year[14]
Easy of cleaning and adjustment	Yes	Yes[30]	Yes
Introduction into the denture	Simple process	Conventional compression molding laboratory process[19]	Conventional compression molding laboratory process[26]
Color	Stable	Stable[19]	Stable[31]
Solubility	Minimum solubility in oral fluids	Meets the ADA requirement of solubility [32]	Does not meet the ADA requirement of solubility[32]
Wettability	Readily wettable	Readily wettable[19]	Better than Novus[33]
Water sorption	Minimum water sorption	Excellent clinical performance despite increased water sorption[34]	Lesser water sorption than Novus
Temperature sensitivity	Temperature insensitive	Temperature insensitive [33]	Temperature insensitive[33]
Radio-opacity	Yes	Yes [19]	No
Durability	Remains resilient for the life of the denture	Remains resilient for the life of the denture [19]	Remains resilient for a year[35]
Shelf life	Long shelf life	Unlimited shelf life, if frozen[19]	Limited

relined prostheses will increase with the increase in the number of elderly patients.[13] Unfortunately, both the methacrylate-based and silicone-based lining material need frequent replacements.[1] These replacements are time-consuming and pose a financial burden on the patient.[18]

The polyphosphazene-based material discussed in this article exhibits a considerable number of the properties of the ideal resilient lining material. These findings suggest an in-depth evaluation of the physical and mechanical properties of this material along with clinical assessment to determine its ultimate suitability as a permanent resilient denture lining material.

References available upon request

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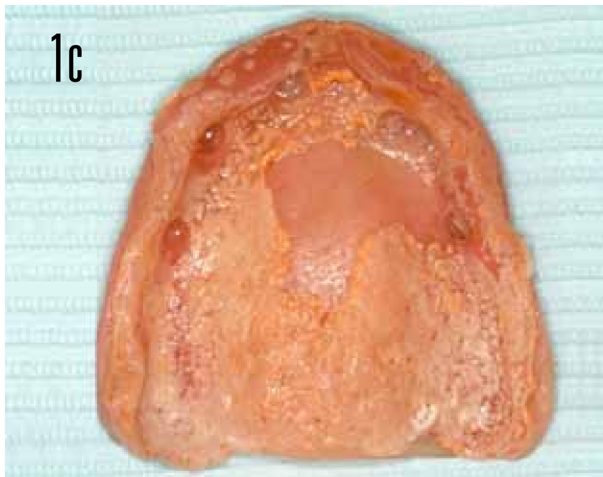

Figures 1a-1d
Comparison of a two- to three-year-old polyphosphazene-based liner (Figs. 1a – 1b) and two- to three-year-old silicone based liner (Figs. 1c – 1d)

QUIZ

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CONTINUING APPROVED EDUCATION

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By Joseph J. Massad, DDS, Swati A. Ahuja, BDS, MDS

Laboratory Steps for Introducing a Polyphosphazene-Based Liner in a Denture

Abstract

There has been an increasing interest in the polyphosphazene-based denture liner (Novus, White Square Chemical, Inc). This article describes the laboratory steps involved in introducing the polyphosphazene-based denture liner in to the denture.

Introduction

Since its reintroduction in 2011, there has been an increasing interest in the polyphosphazene based denture liner (Novus, White Square Chemical, Inc).[1-5] This interest is due to the unique properties of this material including: radiopacity, engagement of bony undercuts, durability (5-year warranty), resistance to biofilm formation,[1,6,7] minimal porosity, excellent shock absorption and patient comfort[8] , unlimited shelf life (when frozen), and acceptable bonding with acrylic resins.[1-5] It is a laboratory processed material and has to be introduced in the denture through conventional compression molding procedure.[1] In spite of all the advantages of the polyphosphazene based denture liner, if the clinical and the laboratory procedures are not carried out accurately, the results will be compromised. This article describes the laboratory steps involved in introducing the polyphosphazene-based denture liner in to the denture.

In order to introduce the liner in to the denture, the dental practitioner appropriately relieves the denture to provide adequate bulk for the impression material and then makes a definitive impression with vinyl polysiloxane impression (VPS) material using the denture as the impression tray. The impressed denture with detailed instructions are sent to the dental laboratory for indirectly introducing the liner in the prostheses.

Technique[9]

1. The impressed denture is poured twice to develop two definitive casts. The denture is not separated from the second cast. The denture is evaluated and base plate wax is added on the cameo surface where the thickness is less than 2-3mm (**Fig. 1**).
2. The denture is invested in a traditional compression molding flask (**Fig. 2**).

Figure1
Base plate wax is added on the denture cameo surface in thin areas

Figure 2
Denture is invested in a traditional compression molding flask



Figure 3
Lines scribed on the polymerized vinyl polysiloxane impression material placed over the denture

Figure 4
Denture removed from the flask following the cooling of the flasks and drying of the separating agent

Figure 5
Acrylic denture base is trimmed with laboratory rotary instruments

3. A vinyl polysiloxane (VPS) impression material (Aquasil monophase, Dentsply Caulk) is placed over the denture to facilitate easy separation of the flasks. Lines are scribed on the polymerized VPS material for retention of investment material (**Fig. 3**).
4. The flask is placed in a boiling hot water tank for five minutes; The two halves of the flask are separated and the baseplate wax is boiled out of the denture flask with clean hot water. The flask is removed from the hot water tank.

5. A tin foil separating agent (Al-Cote Separating Agent, Dentsply International) is applied to the investment material and the cast.
6. Following the cooling of the flasks and drying of the separating agent, the denture is removed from the flask (**Fig. 4**), the impression material is removed completely and most of the acrylic denture base is trimmed using laboratory rotary instrumentation (**Fig. 5**), as is done for a rebase procedure.
7. The thickness and extent of the polyphosphazene-based lining material can be controlled using a pressure formed spacer (Duran 1.5mm, Greatlakes Orthodontics.) The spacer is pressure formed on the duplicate cast. If the margin of the soft lining material has to be placed below the denture border, the spacer should be trimmed 2-3mm short of the intended denture border extension (**Fig. 6**). The spacer is placed on the invested cast and both the spacer and the denture are adjusted to ensure complete closure of the two halves of the flask with no interferences (**Fig. 7**).

Figure 6
Spacer trimmed 2-3mm short of the intended denture border extension

Figure 7
Spacer and denture adjusted to permit complete closure of the two halves of the flask

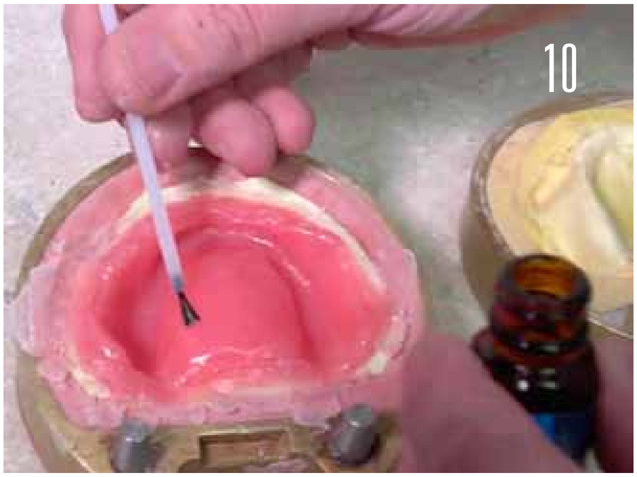


Figure 8
The two halves of the flask are carefully separated

Figure 9
Polyphosphazene material is brought to room temperature

Figure 10
Bonding agent is applied to the intaglio surface of the prosthesis

Figure 11
Polyphosphazene material is placed on the intaglios surface of the denture

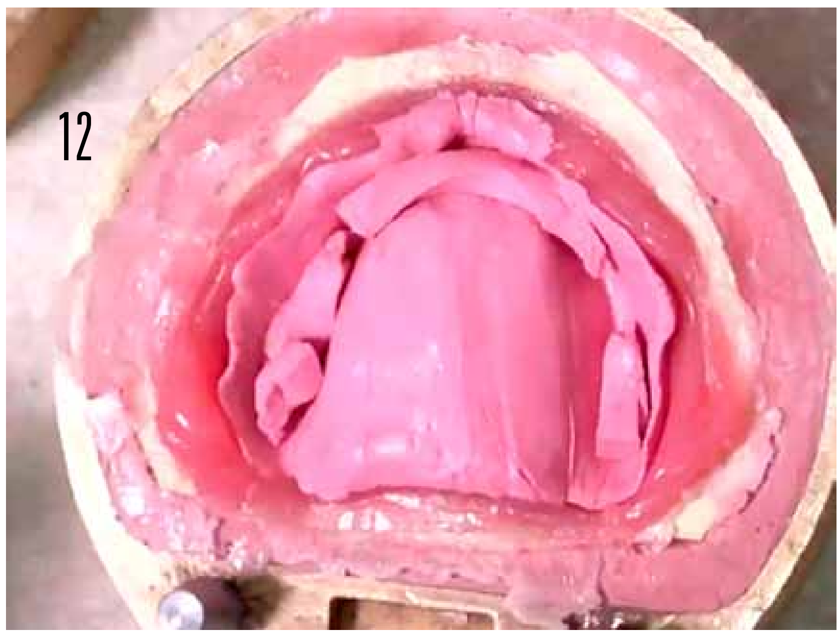


Figure 12
Polyphosphazene material is added to the deficient areas

8. Traditional heat cured denture acrylic resin (Nobiltone High Impact, Nobilium) is mixed as per the manufacturer's specifications, trial packed and then packed in the flask as per the manufacturers protocol.
9. It may be polymerized using the long or the short polymerization cycle (Long Cycle: 8 hrs/165°F and 1 hr/212°F; Short Cycle: 2 hrs/165°F and 1 hr/212°F.)
10. Following the polymerization of the acrylic resin, the flask is removed from the polymerization unit and cooled.
11. The two halves of the flask are carefully separated (**Fig. 8**) and the cast and/or investment are evaluated and repaired as necessary.
12. The spacer is removed from the cast and discarded.
13. A tin foil separating agent is applied to the cast and the investment material and left to dry.
14. The polyphosphazene material is brought to room temperature in preparation for the packing procedure (**Fig. 9**).
15. A bonding agent (Novus bond, White Square Chemical, Inc) is applied to the intaglio surface of the denture (**Fig. 10**).
16. The polyphosphazene material is placed on the intaglios surface of the denture and the flask is closed (**Fig. 11**) in preparation for trial closure; First trial closure is performed at 2000psi for 5 minutes; Second trial closure is performed at 2500psi for three minutes.
17. Following the trial closure, the flask is opened and evaluated. The excess material is trimmed with a blunt instrument and the resilient polyphosphazene material is added to the deficient areas (**Fig. 12**); Final closure is performed at 3000-3500 psi.

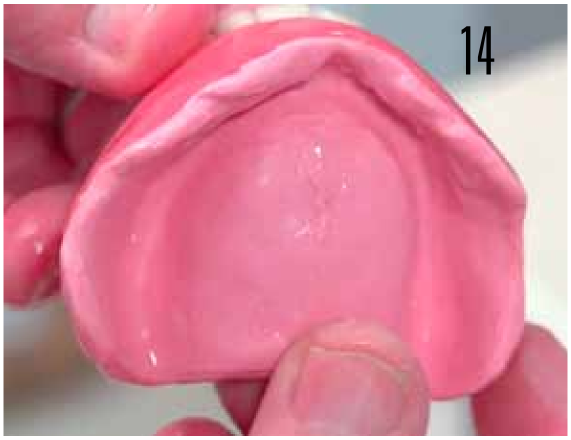
18. The flask is placed in a clamp assembly and the assembly is placed in a polymerization unit.
19. The polyphosphazene liner may be polymerized using the long or the short polymerization cycle (long cycle: 165° F for 9 hours, additional 30 minutes at 212°F; Short cycle 165° F for 1.5 hours, additional 1.5 hours at 212°F.)
20. Following the polymerization, the flask is bench cooled, the prosthesis is divested, finished and polished as necessary with laboratory rotary instruments (**Figs. 13-14**).

Similarly, the polyphosphazene-based liner can be introduced while processing a new denture. However, application of VPS putty (Step #3) is not required during this procedure.

The authors thank Ken Waldo and Eric Newman for the laboratory support. References are available upon request. **JDT**

Figure 13
Denture and the polyphosphazene-based liner finished and polished with laboratory rotary instrumentation

Figure 14
Polyphosphazene liner introduced in the denture



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