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Soft liners

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Soft liner materials

Dentists currently are faced with a selection of many soft liners with a wide variety of uses (Table 1) [1–9]. With the increased number of products available, the dentist must understand the differences in the materials to prescribe, select, and use the product best suited to meet the challenges a patient may present clinically. Even with an appropriate diagnosis and subsequent use of a particular dental material, the prognosis should be given with caution. It often is important to consider whether the treatment should include remaking the prosthesis rather than simply relining a prosthesis for short-term benefit without a plan for long-term success. Relining materials offer the dentist short-term resolutions for a patient's problems.

Soft liner material has been available since the days of vulcanite dentures [10]. The liner material at the time, velum rubber, was comprised of a sponge rubber, which had limitations related the porosity of the material and the ability to adjust and polish it. Velum rubber, originally named for use of the material in cleft palate prostheses, had increased amounts of sulfur and vulcanized as a soft pliable vulcanite [11]. It provided better comfort than most of the vulcanite materials [12]. As early as the turn of the twentieth century, efforts were made to improve the fit and comfort in prosthodontic treatment of edentulous patients, although these efforts were limited by materials available during the time. Before the early 1950s there was limited research on soft liners [13–15]. Many of the publications that were available relied on anecdotal information or case reports.

According to Lytle's [16] publication on abused tissues, zinc oxide eugenol or silicone impression material could be used satisfactorily to treat damaged tissues. In the late 1950s through the early 1960s, tissue

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Table 1
Soft liner materials

Brand name	Manufacturer	Description
Coe-Comfort Tissue Conditioner	GC America[a]	Tissue conditioner
Coe-Soft Soft Denture Reline Material	GC America[a]	Resilient, soft chairside material
Dinabase 7	Quattroti S.R.L.[b]	Long-term tissue conditioning
Dinabase Classic		
F-I-T	Stratford-Cookson[c]	Functional impression and soft temporary relining material
GC Chairside Soft & Extra Soft Denture Reline Material	GC America[a]	Resilient vinyl polysiloxane used as a soft, temporary liner
Hydro-Cast	Sultan[d]	Tissue treatment material, functional impression material
Light Liner Light Cure Chairside Reline Composite	Bosworth[e]	Soft formula available
Luci-Sof Denture Liner System	Dentsply Caulk[f]	Silicone-based liner
Lynal	Dentsply Caulk[f]	Tissue conditioner and temporary liner
Molloplast-B	Buffalo[g]	Permanent soft reline material
Mollosil Plus		
Palasive 62	Kulzer and Co.[h]	
Perma Soft	Dentsply Caulk[f]	Soft reline material
PROFLEX	Dental Resources[i]	
Recon Tissue Conditioner	Hygenic[j]	Tissue conditioner
Sofreliner Chairside Soft Denture Reline	J. Morita[k]	Soft reline material
Softone Tissue Conditioner	Bosworth[e]	Tissue conditioner and functional material
Super-Soft Resilient Denture Liner	GC America[a]	Resilient denture liner
Tempo	Lang[l]	Cushion treatment reliner material
Tokuyama Sofreliner	Tokuyama[m]	Long-term reliner material
Tokuyama Sofreliner Tough		
Tru-Soft Intermediary Relining Material	Bosworth[e]	Soft up to 12 months
Versasoft	Sultan[d]	Silicone denture soft liner
Visco-Gel	Dentsply Caulk[f]	Tissue treatment

[a] Alsip, Illinois.
[b] Porro, Italy.
[c] Westbury, New York.
[d] Englewood, New Jersey.
[e] Skokie, Illinois.
[f] Milford, Deleware.
[g] Syosset, New York.
[h] Armonk, New York.
[i] Maple Lake, Minnesota.
[j] Akron, Ohio.
[k] Irvine, California.
[l] Wheeling, Illinois.
[m] Tokyo, Japan.

Fig. 1. Intaglio surface of mandibular complete denture shows presence of *Candida albicans* on the soft liner material.

conditioners were introduced for use in tissue treatment, for lining surgical splints, for stabilizing a record base, and as a functional impression material [17]. Soon after, short-term liners appeared on the market and were used for tissue treatment or tissue conditioning [18].

By the late 1960s, more durable, resilient soft liners were used [19]. At the time, the two common materials were silicone rubbers including Silastic 390 and Silastic 616 (Dow Corning, Midland, Michigan) and a silicone rubber Molloplast-B (Buffalo Dental Manufacturing Co, Syosset, New York), which currently remains available [20–22]. As with the products available today, the limitation with the silicone rubber products lies in the lack of bonding between the silicone rubber and the acrylic resin base material. Also, fungal growth on and within processed soft liners continues to be a complicating factor (Fig. 1) [23–29].

Material properties

Certain clinical limitations occur with the use of soft liners, primarily resulting from failures in the physical properties of the material [30–38]. Desirable material properties for a soft liner include resilience, tear resistance, viscoelasticity, biocompatibility, lack of odor and taste, adhesive bond strength, low solubility in saliva, low adsorption in saliva, ease of adjustability, dimensional stability, color stability, lack of adverse effect on denture base material, resistance to abrasion, and ease of cleaning.

O'Brien [10] classified the soft liners as being made of either acrylic or silicone. Silicone soft liners include heat-cured liners and those vulcanized at room temperature. A material different from the silicone or acrylic resin soft liners is the poly(fluoroalkoxy) phosphazine elastomeric system. The material developed by Gettleman and others [39,40] was promising. The incorporation of methyl methacrylate provided good adhesion to the denture, and the physical properties were acceptable.

An example of a heat-processed silicone liner is Molloplast-B. This is a gamma methacryloxy propyl trimethoxy silane heat-polymerized silicone

rubber. In the past, this material provided better adhesion to the resin denture base and was less prone to growth of *Candida albicans* than other materials. One drawback is a limited shelf life, which can be increased with refrigeration. The main limitation associated with this material is a lower resistance to tearing than other soft liners. The resilience of silicones is not based on plasticizers but on an intrinsic property of the polymer to retain resilience throughout the working life of the material.

The tissue conditioners are categorized as plasticized acrylics. The soft liner acrylics that are heat polymerized are generally composed of polyethyl methacrylate powder, a monomer of methacrylate ester, and a phthallate ester plasticizer. The monomer may include ethyl, *N*-butyl, 2-ethoxy ethyl esters. The advantage of these materials is their ability to bond to the poly(ethylmethacrylate) denture resin base; a drawback is the loss of plasticizers.

Tissue conditioners may be comprised of poly(ethylmethacrylate), poly(ethylacrylate), or butyl methacrylate. Conditioners are usually made of a poly(ethylmethacrylate) mixture of phthallate plasticizer and up to 25% ethanol. The plasticizer lowers the glass-transition temperature so the rigid acrylic resin becomes rubbery and resilient.

Categories

Currently the International Organization for Standardization (ISO) has issued two international standards related to soft liner materials: ISO 10139-1:1991, Resilient lining materials for removable dentures–Part 1: short-term materials and soft lining materials for removable dentures [41], and ISO 10139-2:1999, Resilient lining materials for removable dentures–Part 2: materials for long-term use [42].

The ISO categorizes a short-term liner as one used intraorally for up to 30 days. A long-term liner is categorized as one that maintains softness and elasticity for more than 30 days. The authors of this article categorize short-term liners as tissue conditioners and temporary soft liners used for up to 1 month following surgical procedures, diagnostic procedures, immediate placement of transitional removable partial dentures and immediate dentures, immediate transitional dentures, and other temporary situations (Fig. 2). Liners used from 1 to 6 months are categorized as intermediate liners. The intermediate liners are made of plasticized acrylic. An intermediate liner placed in a removable prosthesis usually lasts for 1 to 2 months before the plasticizers are leached out and the material loses resiliency.

Although the ISO categorizes a long-term liner as one used for more than 30 days, for this discussion, the authors consider a long-term liner to beone used for 1 year or longer (Fig. 3). These liners commonly are referred to as permanent soft liners because of their relative longevity. Long-term permanent liners are frequently used when preprosthetic surgery is not

Fig. 2. Intaglio surface of mandibular complete denture shows milky, opaque appearance of a short-term conditioner.

indicated but the patient presents with significant bony undercuts or poor residual alveolar ridge anatomy, such as a knife-edge ridge. Many these patients are unable to function with complete dentures without the incorporation of a soft liner. Patients report greatly improved comfort and function when using complete dentures with soft liners (K.D. Rudd, personal communication, 1998). Also, use of a soft liner can increase a patient's tolerance for tissue pain associated with a hard-resin denture base. In a patient with denture stomatitis with *C albicans*, however, use of a soft liner material may exacerbate the tissue discomfort often associated with an increase in fungal growth.

Complicating factors

A soft liner material often is used to reline a removable prosthesis. Boucher [17] stated, "[R]elining of complete dentures is one of the most difficult and trying procedures in prosthodontics, however, it can be effective if the denture was made correctly during the initial fabrication and if a precise technique is performed with meticulous attention to every detail." Before a soft liner is used, the prosthesis must be evaluated and deemed

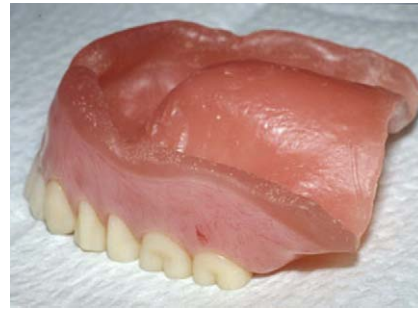

Fig. 3. View of maxillary complete denture shows the color difference between the long-term soft liner material and the denture-base hard acrylic resin.

clinically acceptable; the liner material should not be used to compensate for a poorly made, ill-fitting prosthesis. A liner, whether hard or soft, should be used as a simple tool to improve a clinically acceptable prosthesis.

Brown [31] described the success of using a soft liner with a simple analogy: ''Hit the table in front of you with your hand, and it is a painful experience; cover it with a sheet of foam rubber, and do it again, and there is no pain.'' Use of a soft liner may make the difference in a patient's being able to function with a removable prosthesis such as a complete denture and not being able to function properly. Patients may have intraoral anatomic features such as a sharp, bony residual alveolar ridge or bony undercuts for which surgery may be contraindicated. The key rationale for use of a soft liner in this instance and in related clinical scenarios is based on its intrinsic resilience, that is, its ability to absorb energy as the material undergoes deformation. Clinically, energy is absorbed by the soft liner material and not by the underlying, supporting intraoral tissues. The soft lining material allows a ''uniform distribution of stress at the mucosa/lining interface'' but does not necessarily reduce transmitted forces [5].

Authors have described why a reliner material fails as a denture reliner. If the existing prosthesis is poorly made or does not fit well, the existing soft tissue problems can be exacerbated with a relining procedure, regardless of material quality. Winkler's [43] initial description, based on incorrect diagnosis and similar to Boucher's statements, concluded that a denture that should be rebased or remade can never be relined successfully. If the existing intraoral tissues are in poor condition, the abused tissue is an inadequate foundation for successful prosthodontic therapy. Some dentists may conclude that, if all else fails or patients are having considerable difficulty with their removable prostheses, dental implants should be considered. Dental implants should not be viewed as a substitute for adherence to fundamentally sound prosthodontic principles, however. For a patient who cannot afford dental implant treatment, use of a soft relining material is a poor substitute for a well-made removable prosthesis Winkler [43] states, ''All relined procedures will cause a change in vertical dimension due to the addition of new material, to the tissue side of the denture base.'' Incorporation of too much material significantly affects the interocclusal space necessary for a patient to function properly.

Denture bases also may shift during relining procedures. The increased amount of material in the dentures may shift the dentures forward and affect both esthetics and occlusion. Patients may complain of increased fullness or that the ''dentures are too big, don't look right, don't bite right.'' As with other common dental materials (eg, the routine use of alginate impression material), the ease of use of some soft liners makes it easy to abuse the material.

Nikawa et al [26] have shown that different components of soft liners affect the growth, acid production, and colonization of *C albicans*. They studied the affects of polymer particle size, ethyl alcohol content, and type

of plasticizer. They found that the size of polymer particle had little effect on *C albicans* growth. The amount of ethyl alcohol content and type of plasticizer made a significant difference, however.

Increased ethanol content with benzoyl salicylate increased fungal colonization. With benzyl *N*-butyl phthlate, however, the fungal growth rate decreased. With plasticizers, benzoate, and benzyl salicylate, colonization decreased, whereas colonization increased with the use of dibutyl phthalate butyl, *N*-butyl phthalate, and butyl phthalate butyl glyconate.

Clinical uses

Tissue conditioners offer alternative materials for practitioners who manage patients in today's esthetically conscious society. Most patients are reluctant to be without their dentures at any time, and many patients state that their spouses or partners have never seen them without their removable prostheses. Patients are more active than in previous years, in both professional and recreational activities. A dentist's request that a patient remove the prosthesis for a brief period, and even more for a day, may be considered an impossible demand. Patients may be more amenable to having a series of appointments using a tissue-treatment material than to going about daily activities without removable prostheses (ie, maxillary and mandibular complete dentures).

Lytle [16] reported differences found in patients who used dentures continually and those who removed the prostheses throughout the night. In conventional treatment, patients who have abused tissues are instructed to leave the dentures out of the mouth, or the dentist prescribes and uses a tissue-conditioner material, changing the material every 3 days for a series of three relinings. Chase [44] first described use of tissue-treatment material in 1962. Use of tissue-treatment material expanded in the complete denture teaching techniques of Earl Pound [45]. The technique used both the resilient and short-term qualities of a tissue conditioner to enhance clinical outcomes in denture fabrication.

Tissue-treatment material, when mixed, results in a gel of the polymer and monomer with a resilient consistency. The resilient gel provides an excellent cushion for traumatized tissue adjacent to the intaglio surface of the hard, processed denture-base material. When the tissue-treatment liner is replaced frequently, the damaged intraoral supporting tissues can return to a state of health. Effective use of any tissue-treatment material may require replacement every 3 days for 2 weeks or longer.

Before a tissue conditioner is applied, the intraoral tissues must be clean and dry. Although most dental materials should be mixed according to the manufacturer's instructions, the mixing instructions of some tissue-treatment materials can be altered depending on the desired viscosity and flow needed clinically. Once the material is placed on the intaglio surface of a prosthesis and seated intraorally, the material is allowed to flow as the

patient closes the bite into maximum intercuspation or appropriate interocclusal relation. After the material sets, excess amounts are trimmed using a sharp, heated scalpel.

Placing a tissue conditioner in a prosthesis for frequent liner replacement is a relatively simple procedure, but a soft liner material that is not changed frequently can cause additional tissue damage. Improper use of tissue-treatment material and failure to change the material according to the manufacturer's instructions can exacerbate the clinical condition. Plasticizers that leach out of the material can result in a hardened material. Parts of the liner may wear out or peel off, affecting the intraoral tissue foundation. This problem is seen particularly in patients with immediate dentures who have had a soft relining and who do not return for a post-insertion follow-up appointment.

Diagnostic relining

A diagnostic relining is indicated in several clinical scenarios. It may be used in conjunction with a diagnostic acrylic resin removable partial denture, also referred to as a temporary or transitional prosthesis. Diagnostic removable prostheses can be used to evaluate the patient's occlusal vertical dimension, to re-establish esthetics, or to ascertain whether a perspective patient can tolerate and accept a removable prosthesis. The diagnostic relining can be used in preventive program to evaluate oral hygiene or to evaluate a patient's commitment to maintaining a prosthesis before undertaking a major financial obligation for prosthodontic treatment.

A diagnostic, reversible procedure of this type can be interpreted as a treatment of last resort to preserve remaining natural teeth. This procedure can also be used to evaluate an existing or repaired complete denture or other removable prosthesis, and this evaluation, in turn, can help determine proposed changes for a new prosthesis. A diagnostic soft liner can be beneficial in determining the eventual thickness of a hard relining; a periodontal probe can be inserted through the material to measure the thickness of the soft liner. The measurement of the volume or thickness of the soft liner can indicate the volume of bone resorption often associated with loss of natural teeth.

Once the soft liner is placed, the dentist may need to replace it with a processed hard relining material, or evaluation may show that a new prosthesis is necessary. When the prognosis includes possible significant modification of an existing prosthesis, the dentist may want to duplicate the original denture before placing the soft liner. If this diagnostic phase is unsuccessful, the patient still has an intact prosthesis because the material can be removed; the modifications made using a soft liner material, such as a tissue conditioner, are reversible.

Impression material

A number of dentists use tissue conditioner as a border-molding material and as an impression material for edentulous and partially edentulous patients [46]. The dentist can prescribe a series of soft relining procedures using a tissue conditioner to evaluate borders (ie, depth and thickness of a border in relation to muscle function; also considered a preprosthetic diagnostic procedure). The final placement of soft liner material can be used as the final impression either following the initial set of material (as with other final impression materials) or by having the patient wear and function with the prosthesis for a defined period of time. Some dentists may even have the patient eat something to generate an in-the-chair assessment of functional rather than having the patient wear the prosthesis for a defined period of time.

Another method of making a functional impression is selective finger-pressure placement following a selective-pressure impression technique. This technique is similar to that used in making an impression for an altered cast procedure for a bilateral distal extension removable partial denture or for a final impression for a complete denture. In one example, the functional impression can be made in the definitive prosthesis at the insertion appointment [47].

Immediate complete denture

Patients' needs for removable prosthodontic treatment in the future have been confirmed [48]. Fabrication of immediate complete dentures offers an acceptable transition for a patient and allows the patient to continue to function socially. In a conventional clinical protocol for a patient with immediate dentures, posterior teeth are removed 6 weeks before construction of the immediate prosthesis. Patients may retain up to six anterior teeth in one or both arches during the initial healing phase. During the insertion appointment, the remaining natural teeth are removed, and the maxillary and mandibular immediate complete dentures are placed. Although some dentists may place soft liners along with insertion of the immediate prostheses during this surgical appointment, this practice should be discouraged. If made well, the new immediate complete denture should be well adapted to the previously healed tissues except around the recent extraction sites.

Soon after the surgical and prostheses insertion appointment, a patient may complain that the dentures are loose. There is a tendency to reline the dentures too soon at the request of the patient. A hard clinical relining is usually indicated 6 months to 1 year after extractions. A soft liner may be used as soon as the surgical and prostheses insertion appointment or as late as 2 months before the hard relining process (Fig. 4). The patient will need to be evaluated frequently to help determine when the soft relining material should be placed; the series of appointments for maintenance should begin before the final hard relining/replacement.

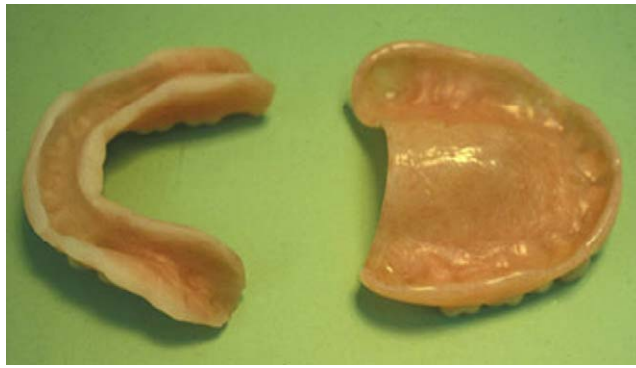

Fig. 4. Intaglio surfaces of maxillary and mandibular immediate complete dentures. The mandibular immediate denture has an intermediate soft liner that appears as a semitranslucent material.

Surgery and implant therapy

Following preprosthetic surgery, temporary soft liners are used to meet functional needs. Using a soft relining material improves adaptation to the prosthesis because the material helps reduce edema and control postsurgical bleeding, much like a pressure bandage. This function and use differs from using the material for simple tissue conditioning. Soft liners are used after removal of exostosis, tori, tuberosity reductions, or reductions in the mylohyoid ridge. After surgery the soft material works well to fill any void between the soft tissues and the intaglio surface of the removable prosthesis. The need to replace the material still exists, and appropriate patient follow-up is required to avoid further complications related to material limitations.

Soft liners are used in prosthodontic implant therapy. Patients who have an implant placed following a two-stage implant surgical protocol are advised not to use any removable prosthesis immediately following surgery and to leave their removable prostheses out for approximately 2 weeks. The intaglio surface of the denture is relieved considerably to create a space over the implants; the intent is to avoid direct contact between the hard denture-base material and the implant. A soft liner material is placed to minimize direct pressure on the tissue covering the implants and to provide a broad distribution of occlusal forces transferred to supporting tissues. The soft liners can be used intraorally over implant sites to modify a temporary complete denture or a temporary removable partial denture. In each case, the soft liner material must be changed frequently to maintain resiliency.

Soft liner materials can be used in conjunction with mechanical attachments or other simple retentive attachments in either an interim or a definitive removable prosthesis. In similar manner, the material is used as a permanent soft liner covering the denture base to improve soft tissue adaptation.

Summary

The article provides a background for understanding the properties of soft liner materials, describing associated problems, and discussing clinical applications of soft liners in dental practice. Although not a panacea, soft liner materials provide the practitioner with a valuable tool in providing excellent clinical care for patients.

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