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Soft denture liner and its additives (A review of literature)

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Abstract:

Soft liners are used with patients who cannot tolerate the hard acrylic base. It is used in complete and partial removable dentures to distribute functional loads homogeneously on the denture-bearing tissues to increase patient acceptance and relieve pain. These materials are recommended in cases of irregular bone resorption, bony undercuts, thin atrophic mucosa, immediate prosthesis, healing after implant placement, and for patients with bruxism and xerostomia.

However, the structure of the soft liner encourages the colonization of microorganisms, so the soft liner must be modified to overcome any possible infection that may occur during use, especially to prevent denture stomatitis, the most common disease associated with denture wearing caused by candida albicans.

Keywords: Soft liner. Antimicrobial Agents in soft liners. Essential oils activity. Nanoparticles as anti-fungal. Plant powder extract**.**

Introduction:

For many years, Polymethylmethacrylate has been extensively used and developed to construct acrylic denture bases (AlFuraiji *et al.*, 2024), which have good aesthetics, low toxicity, and a low water absorption rate (Noori *et al.*, 2023). However, the disadvantage is that it has inferior physical and mechanical properties and is susceptible to microbial colonization (Al-Shammari *et al.*, 2023). The use of nanoparticle fillers is one method that has successfully improved the characteristics of dental resin matrix (Al-Sammraaie *et al.*, 2024).

Denture base relining:

A decisive part of the complete denture benefit is maintaining the adaptation of the denture base to the mucosa covering the residual ridges. Bonding between the denture base and relining materials is a very critical technique that may lead to microleakage at the denture base relining interface and then detachment of the relining material. The main indications of relining material are Poor adaptation of the denture to the supporting tissues, Sharp bony protuberances, Pressure points, Flabby and anthropic tissue, and Irregular, sharp, and bony ridges that cause painful mastication (Alfahdawi, 2018). whereas there are also contraindications of

relining, like Severe resorption of the residual ridge, Abused soft tissues, Temporomandibular joint disorder, the poor appearance of the existing dentures, problems in speech, and osseous undercuts are severe (Nallaswamy, 2017). The classification system for relining materials is based on consistency, including Tissue conditioning materials, Hard denture liners, and Soft lining materials. (McCabe & Walls, 2008)

Soft linings material:

Soft denture liners can be helpful for individuals who are unable to tolerate a traditional rigid denture foundation (Al-Rubaie & Al-Khafaji, 2024). A soft lining on the denture base will help to increase patient acceptance of the denture and relieve the pain, especially in cases where a thin, non-resilient mucosa covers the irregular mandible alveolar ridge (McCabe & Walls, 2008).

Soft liner materials are divided into two types according to composition: Silicone and acrylic, which are either heat-cured or auto-polymerized. According to duration, short and long-term soft liners. Short-term soft liners are normally applied for one month; intermediate liners retain elasticity from one to six months, and long-term permanent liners soft liners last more than one year (Dutta, 2022).

The soft lining material, to be ideal, must be Easy to manipulate with conventional laboratory equipment, Dimensional change during processing should be minimal, like that of the denture base materials, minimal water sorption and solubility, Resiliency should be high, Bond strongly to the denture base, sufficient tear resistance, easy to clean, non-toxic, tasteless and odorless, Its color should match that of the denture base material (Babu, 2019). The uses of soft lining material include Diagnostic relining, Impression material, If the patient suffers from mucosal discomfort and ulcerations, it can be used with immediate dentures, in the severely resorbed ridge and bony undercuts, improve the retention of the denture to the underlying tissue; soft-liners are used to reline the obturators for patients with congenital or acquired maxillofacial defects; patients suffering from xerostomia have increased soreness and discomfort, use to improve the adaptation of the denture after surgery, and use after-implant therapy to cover the implant site (Babu, 2019). The soft liner can also be used when the patient has financial constraints and is unable to pay for a new denture (Wadi & Khalaf, 2024).

Types of soft lining materials according to composition:

There are two types:

I. Plasticized acrylic resin-based soft liner:

Acrylic soft lining materials come in liquid and powder form, the liquid consisting of a higher MMA monomer (e.g., ethyl, n-butyl) and the powder consisting of a higher PMMA polymer. Also, the plasticizer is a phthalate (Chladek *et al.*, 2014).

Auto-polymerized acrylic soft-liner materials permit the clinician to do relining for removable dentures orally or extra orally. This method, when compared to the heat polymerized technique, is faster in use. However, producing liner materials with the optimum thickness is difficult when using the auto-polymerized technique. The maximum thickness for good shock absorption is around 2.5 to 3 mm. Two processes occur when acrylic resin-based denture liners are submerged in water: the plasticizers leaching out and other soluble materials in the water, whereas the polymer absorbs the

water. The plasticizer makes the polymer's glass transition temperature below mouth temperature, reducing the resilient material's modulus of elasticity to a satisfactory level (Chauhan *et al.*, 2021).

II. Silicone–based soft liners:

Silicone-based soft-liner materials resemble silicone impression materials in composition (dimethyl siloxane polymers). Polydimethyl siloxane is a viscous liquid that can cross-link to form a rubber material with strong elastic properties. There is no plasticizer required with this material to make a softening effect(Chauhan *et al.*, 2021).

This material lacks leachable plasticizers. Like silicone-based impression materials, these materials gain elastomeric properties with a silicone base and catalyzer mixture. The most important advantages of this material are ease of use and long-term softness. An adhesive is necessary since their connection to the acrylic denture base is not direct. A new generation of adhesives has much stronger connective properties but is still insufficient (Özkan, 2017). Finally, it can be used in case of complete dentures against natural dentition.

Antimicrobial Agents in soft liners:

Colonization of candida albicans is one of the serious flaws of soft-lining materials, which might eventually lead to denture stomatitis (Abdulwahhab & Jassim, 2018). Denture-induced stomatitis is an inflammatory disorder that affects the mucosa beneath removable dentures (Naser & Abdul-Ameer, 2023).

1-Essential oils added to soft liner:

In 2015, Tea tree oil was also known to have antifungal properties, especially against candida albicans, and the study found that tea tree oil aids in eradicating fluconazole-resistant candida in AIDs patients. A concentration of 0.25 percent of this oil can inhibit candida's multiplication by creating germ tubes. Tea tree oil can be used to soft liners and tissue conditioners to help with denture-induced stomatitis, suggesting a new oral candidiasis management method (Pachava *et al.*, 2015).

In 2017, seed oils were organically derived medicaments put into soft liner materials or tissue conditioners (800 µL) and have been shown to have potent anti-candida albicans efficacy (Muttagi & Subramanya, 2017).

In 2018, Virgin coconut oil was successfully added to the soft denture liner and acted as a potential antifungal agent against Candida albicans. The Addition of 1.5% and 2.5% of coconut oil used asses the antifungal effect. 1.5% is better because it has the most beneficial effect against fungi, with good wettability and softness values and fewer adverse effects on the shear bond strength (Alamen & Naji, 2018)

In 2021, an investigation found that 20 v/v % curcumin oil added to a soft liner significantly reduced surface roughness compared to the untreated soft liner. Both empirical ratios of curcumin, 10 and 20% v/v, considerably improved the binding strength between the liner/base interface and its antifungal activity (Abdallah & Aref, 2021).

In 2021, a study evaluated the effect of Artemisia aerial oil and ethanol extracts on candida albicans growth and shear bond strength of soft denture liner.

The results showed that all oil concentrations inhibit candida albicans growth except 12.5 mg/ml, and the shear bond strength of the soft liner did not significantly differ from the control. In ethanol

extract, only 75 and 100 mg/ml concentrations inhibited candida albicans growth, and there were significant differences between all concentrations. At the same time, shear bond strength was increased, and there were significant differences with the control (Rashid, 2021).

In 2022, lemongrass essential oil was also investigated to assess antifungal properties, which can be regarded as a strong antifungal material, and incorporating it into a soft liner can successfully produce a soft lining material with antifungal activity against Candida albicans microorganisms. Significant improvement was made in most tested properties with concentrations of 2.5% and 5% v/v of lemongrass essential oil (Naser & Abdul-Ameer, 2022).

In late 2022, Litsea Cubeba Essential Oil was successfully added to the soft denture liner and acted as a potential antifungal agent against Candida albicans. The minimum inhibitory concentration of Litsea Cubeba Essential Oil against Candida albicans was 1.25% v/v (Songsang *et al.*, 2022).

So, it is unsurprising that herbal extracts have different antifungal and antibacterial properties. This is due to differences in the plants, their different extract methods and processing, the genetic structure of bacteria and fungi, and the same or different species of microorganisms (Petrović *et al.*, 2014).

2- Nano Particles added to soft liner:

In 2011 and 2021, silver nanoparticles were added to soft denture liners to assess their antifungal properties (Chladek *et al.*, 2011; Deng *et al.*, 2021). With long-term use, the acrylic soft liner containing silver nanoparticles synthesized in situ effectively controlled candida albicans adhesion (Deng *et al.*, 2021).

In 2017, Zirconium nanoparticles were successfully added to the soft denture liner and acted as a potential antifungal agent against Candida albicans. A highly notable decrease in Candida albicans colony in experimental groups of 1% and 1.5% of Zirconium nanoparticles in contrast with the control group. There was no inhibition zone around any specimen of the tested groups. However, there was a significant increase in the mean value of shear bonding strength after incorporating a 1.5% percentage into the soft liner (Yasser & Fatah, 2017).

In 2020, an investigation found that 1.5wt% and 2wt% of chitosan nanoparticles added to a soft liner showed a significant decrease in the number of Candida cells adhered to a soft liner compared to samples of the control group (Mohammed & Fatalla, 2020).

In 2020, Adding 3wt% of magnesium oxide nanoparticles to the denture soft liner provided better antimicrobial activity than the control group. It significantly suppressed the growth of candida albicans and Staphylococcus aureus for up to six months (Abdel-Rahman, 2020).

In 2021, Copper Oxide Nanoparticles were added successfully to the soft denture liner. Incorporating Copper Oxide Nanoparticles at a concentration of 500µgmL into the soft denture liners exhibited significant activity in inhibiting candida albicans (Ansarifard *et al.*, 2021).

In 2022, a study aimed to determine how adding silicon dioxide nanoparticles to soft-lining materials affects Candida albicans adhesion, contact angle, and surface roughness. The result of adding 0.25% and 0.5% of silicon dioxide nanoparticles to the acrylic soft liner shows a decrease in candida albicans' adhesion, contact angle, and surface roughness (Gad *et al.*, 2022).

In 2022, Adding 1% and 1.5% by weight of Barium titanate nanoparticles into the soft liner improved the antifungal activity of the soft denture liner, while surface hardness did not significantly change (Abdulbaqi, 2022).

In 2022, 2% w/w silver zinc zeolite nanoparticles were incorporated in a soft denture liner to investigate the antifungal properties and showed a superior effect on all tested groups (Ferreira *et al.*, 2022).

In 2023, The result of the addition of 1.0 wt.%, 1.5 wt.%, and 2 wt.% titanium oxide nanoparticles into a heat-cured soft denture liner showed antifungal activity observed by the reduction of candida albicans colonization. When titanium oxide nanoparticles' concentration increased, the soft liner's anti-microbial activity also increased (Ahmed *et al.*, 2023).

3- Plant powder extract added to soft liner:

In 2018, a study aimed to investigate the effect of Aloe vera powder with concentrations of 3% and 10% incorporated with heat cure acrylic soft-lining material on the adherence of candida albicans, tear strength, and shear bond strength. This study's results indicated that both aloe vera concentrations showed a higher decrease in Candida albicans cell count compared to the control group, a non-significant difference in tear strength, and a significant increase in soft liner shear bond strength for the experimental groups (Abdulwahhab & Jassim, 2018).

In 2020, a study was conducted on Piper betle extract with varying concentrations from 0.25 to 20% w/w to investigate a short-term soft lining material's anti-candidal properties, surface hardness, and gelation time. A soft liner containing at least 5% w/w of Piper betle powder showed an inhibitory effect against candida albicans, and this concentration did not significantly alter the surface hardness and gelation time of soft lining material. A larger inhibition zone was calculated with increased concentration of Piper betle (Kumpanich *et al.*, 2020).

In 2020, grape seed extract was added to the soft lining material to assess the antifungal activity, tensile bond strength, and surface roughness. Both concentrations of grape seed 5% and 10% w/w exhibit a significant increase in antifungal activity and tensile bond strength, while the concentration 5% w/w showed a considerable increase in surface roughness (Aref, 2020).

In 2023, a study was conducted to compare the antifungal efficacy of soft liner incorporated with powder extract of Lawsonia inermis and Withania somnifera on candida albicans growth. The concentration of Lawsonia inermis and Withania somnifera powder extract was 1%, 3%, 5%, and 7% incorporated in the soft liner, and the inhibition zone against candida albicans was calculated to measure the antifungal properties. The result was that Lawsonia inermis and Withania somnifera natural herb extracts have been shown to have antifungal activity against candida albicans with all concentrations used of these natural plant powders (Jaiswal *et al.*, 2023).

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Conflicts of Interest Statement ……

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