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A Systematic Review of Soft-Liners Use in Edentulous Patients

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Abstract: ***There are different applications of soft liners in prosthetic dentistry due to viscoelastic properties. They have various uses in special clinical purposes, including distinct bone undercutting and bone resorption, where traditional prostheses are too hard to bear for edentulous and elderly patients. Their use also reduced trauma and improved retention by avoiding any kind of direct contact to solid dentures and exposed tissues. Though there is no specific soft material, the choice of technique and type should consider patients' clinical status. One should never consider soft liner to fix errors in prosthetic design. Soft bases are restricted usually due to ageing. The adhesion to hard base would be less and ageing also leads to fungal colonization and colorability. It is recommended to use various disinfection techniques and products properly and maintain good oral hygiene to retain the mechanical and physical properties of soft liners for the long time and avoid constant renewal of them. Despite the fact that soft bases are relatively less common, they are known to have merely therapeutic results in different cases of highly advanced "bone resorptions" among elderly people. It is important to keep the patient aware about the benefits of good oral hygiene and control visits to ensure best results and to deal with the problems due to wear and tear of the material.***

Keywords: prosthetic dentistry, edentulous patients, elderly patients, soft liners, oral hygiene, fungal colonization

1. Introduction

Mucosal tissues become sensitive and fragile over time to pressure due to senile atrophy. They get recovered slowly and eventually lose the chance to be strong enough to hold detachable prostheses. Mucous membrane also lose elasticity and hydraulic cushioning is also lost, which acts as a shock absorber in case of prosthetic pressure. As a result, mucosal tissue is strained between the bone and prosthesis (Hashem, 2015; Louis et al., 1992). Due to this reason, patients suffer from unbearable pain due to detachable prostheses which contain solid bases (Gupta et al., 2013; Hashem, 2015).

Especially in patients with maxillae having advanced resorptions, it may also be detected around the nerve emergences. These patients may not be able to handle pressure on those areas as in the case when an elderly patient had "mandibular lower alveolar canal". The mental foramen reaches the upper area of alveolar ridge when capped by thin lamina (Louis et al., 1992).

1.1 Background

Soft liners dentures are the soft layer fitted in between the surface of the teeth and oral tissues. These can be used as partial or complete denture and are removable in nature, it supports the function of the oral tissues. Soft liner dentures are a type of traditional detachable full denture with a soft polymer orthodontic material decided to apply to the denture's tissue fitting surface acts as a shock absorption cushion when chewing. The soft inner surface is made of a specially formulated dental plastic. Despite tissue anomalies, sharp bony areas, and tissue undercuts, this material is designed to make your new teeth more pleasurable and efficient. This lining material forms a spongy, padded layer between such a denture's hard base as well as the connective tissue in the mouth. Dentures with soft linings can be more comfortable. They can provide confidence and ease of chewing for denture wearers. They can also make your dentures feel more natural and far less visible in your mouth.

1.2 Short-and Long-term soft-liners

Following a surgical procedure, short-term liners as well as tissue conditioning systems are used at the same time. Tissue conditioners are typically composed of poly ethyl methacrylate powder, scented esters, and alcohol. These materials do not contain methacrylate monomers.10 Tissue compressors can be utilized for few days to a week, but they should only be used for a short period of time. Long-term smooth liners are generally made of either plasticized acrylic or silicone. Due to hardening as well as water sorption, plasticized acrylics typically have such a shorter service life. They have a similar composition to denture base polymers, but with a higher percentage of plasticizers. Plasticizers keep those substances soft, but these assets degrade over time.

1.3 Types of Softliners

- Denture Bases with Heat Cure Lining-A silicone adhesive liner can be introduced to a properly established denture base as part of a reline procedure, or it can be included during the initial fabrication.
- Materials for Self-Administered Relining-There are numerous sorts of lining substances to be had, allowing the affected person to try and improve the in shape of unwell-fitting dentures or to provide a soft cushioning impact to the proper floor. Such items are commonly available for buy at a ramification of stores, inclusive of supermarkets or chemist shops. Methacrylate or vinyl polymers which includes polymethyl-, polyethyl-, or polybutylmethacrylate or vinyl acetate are normally used in the goods, at the side of a plasticizer including butyl phthalate and a solvent together with acetone, ethanol, or toluene. Such merchandise declares to enhance the healthy or consolation of a denture without requiring a go to the dentist.

1.4 Maintenance of the Soft-liners

One of the most tiring and challenging prosthodontic procedures is realigning complete dentures. However, denture must be made properly at the time of fabrication and precise technique should be done with proper attention to detail to make it effective. Before using soft liner, it is important to evaluate prosthesis and ensure that it is clinically acceptable. This material is not recommended to compensate for poorly fitting, cheap quality prosthesis. Whether soft or hard, a liner must be easy to improve prosthesis which is clinically acceptable. If the current prosthesis is not well-suited or of cheap quality, the reclining procedure may cause problems in soft tissue. Soft liner must be used in a denture which fits perfectly and is properly fabricated.

It is not recommended to use brushing or mechanical cleansing as it can affect resilient lining (Garcia et al., 2003). So, it is better to use denture cleansers to conduct chemical cleansing and control denture plaque in conditioners of tissues (Meşe, 2006). When it comes to denture cleaning, some of the best solutions are alkaline hypochlorite, alkaline peroxide, enzymes, disinfectants, and acids as per their chemical properties. Peroxide cleansers are the denture cleansers which are most widely used (Budtz-Jørgensen, 1979). They are used in the form of tablets or powder which turn out to be alkaline hydrogen peroxide solutions when they are softened in water (Zarb et al., 2013).

Hypochlorite can be helpful as denture cleanser as it can get rid of stains, dissolve organic elements like mucin, and has fungicidal and bactericidal properties. Soft, silicone-based liners are better in cleansing as compared to acrylic-based soft liners. Silicone-based ones are more compatible to cleansing liquid and they can handle their resiliency very well. They are supposed to be very promising for usage in the long term. All such chemicals are reactive to the liners. So, it is recommended to use cold water and soft cloth to clean the surface of soft liners.

1.5 Related Studies

According to the view of Thakur and Singh (2018), soft liners lining the specimens and dentures were then tested for softness with a durometer and surface integrity with a scanning electron microscope (SEM) at baseline and 3 weeks in vitro. Patients in Group I (the control group) wore dentures lined with uncoated soft liners and coated with a surface conditioning agent, while patients in Group II (the treated group) wore dentures. The study's findings suggest that surface coating can reduce softness and surface integrity loss while also increasing longevity in both in vitro and in vivo conditions.

There are different uses of tissue conditioners like recording proper impressions, treatment of abused tissues, temporary realigning of obturators and surgical splints, and other applications as they are known for different viscoelasticity. However, how well they work in complete denture is still a matter of debate, even though they have been proven as functional material. Baslas et al. (2014) found a tissue conditioner technique to use it as “functional impression material”. They have highlighted the right approach of use, specific impression material properties, manipulation and precaution in various situations to achieve the right impressions.

It is very important to know the benefits and role of a treatment on overall lifestyle quality. Pisani et al. (2012) conducted a study on the use of denture relining by the patients and improvements in “oral health related quality of life (OHRQoL)”. As per the chairside procedure, silicone-based soft liners are used to reline lower dentures of 32 patients. The researchers assessed quality of life before 3 months of relining and after 3 months of it with “OHIP-EDENT” and conducted Wilcoxon test to compare median scores. Significant improvements have been reported by participants after 3 months. Hence, there might be a positive impact of soft liner on the overall health of edentulous patients.

1.6 Methodology

A synthesis-based systematic study includes a protocol and outcomes from all available research on the topic of interest, as well as a thorough examination of the impacts, abilities, and shortcomings of the accumulated research.

2. Discussion

Soft denture reliner forms a softened layer between oral mucosa and solid denture base. The liners help in more even distribution of the mastication forces to the given tissues as it absorbs some of those forces (McCabe et al., 2002). Soft liners can comfort denture patients with non-resilient, thin mucosa, ridge atrophy, bruxomania, and bony undercuts (Murata et al., 2002). They are also ideal for quick prosthesis, uneven bone resorption, xerostomia and bruxism, and implant placement recovery (Dootz et al., 1993; Gjengedal et al., 2013). The failure or success of soft denture liner relies on material used and knowledge of how these products work, along with biological and physiological properties of oral tissues where denture is placed.

2.1 Advances in the soft denture liners

There are so many techniques to improve adhesion and bond of the liners. Making acrylic interface rough with lasers and alumina abrasion can fix the problem (Usumez et al., 2004). Chemical etching with methylene chloride, acetone, and MMA on the surface can be used to improve bond and strengthening of acrylic with netted glass fibres (Mutluay & Ruyter, 2007; Hatamleh et al., 2010). Alternative method for surface roughening like oxygen plasma has also been able to improve the strength of tensile bond between soft liner and denture base resin (Zhang et al., 2010). The microorganism build-up is one of the major issues of soft liners (Bulad et al., 2004; Graham et al., 1991). Microorganisms first stick to the lining area and eventually get through the material. This way, Silver (Ag) is very popular and widely used in medicine due to its antimicrobial properties. It is used for its low toxicity and better tissue response. It is more effective against fungi and sessile bacteria colonizing the plastic area than any other metal (Nam, 2011). Soft liners can be modified by AgNPs for their anti-bacterial and anti-fungal

properties (Tanagawa, 1999). These bactericidal and fungicidal properties can be improved significantly with silver nanoparticles (Fan et al., 2011; Chladek et al., 2012).

2.2 Properties of Dental liners

Liners are very common in dentistry to redesign prostheses around oral cavity's soft tissues (Ahmad et al., 2009). Uneven surfaces, adhesion failure, and hardness changes are the reasons for build-up of microbes. They affect the durability of liner and cause oral health issues like loss of implant (Rosenberg et al., 1991; Mombelli & Lang, 1998), denture stomatitis (Valentini et al., 2017), respiratory issues (Matsuura et al., 1997), osseointegration delay, and peri-implantitis (Mombelli & Lang, 1998), which can affect the quality of life and success of rehabilitation treatment.

Liners can be made of "polymethylmethacrylate" (Zarb et al., 2004; Anusavice et al., 2012), which makes it hard (Urban et al., 2009; Chaves et al., 2010), or resilient (Atsü & KeskIn, 2013; Liao et al., 2012) when plasticizers are used in the resin (Bail et al., 2014; Santawisuk et al., 2013). Resilient liners must absorb energy, be elastic and act on the cushioning impact (Bail et al., 2014). Resilient relines are also considered as long-or short-term products. The resilience can be held for over 30 days with long-term denture liners and useful for over a year, while short-term liners are ideal to be used for over 30 days, according to "International Organization for Standardization (1999) ". Liners are pretty more cost-effective and non-invasive in comparison to new denture (De Rezende Pinto et al., 2010; Kutlu et al., 2016). Resilient liners are more preferred over hard liners as they are more comfortable (Mante et al., 2008).

2.3 Soft liners for Elderly Edentulous Patients

Long-term soft liners remain soft for over 30 days and can last around a year, while their short-term counterparts can be used only up to 30 days (Kreve & Dos Reis, 2019). Silicone liners are more durable and mechanically stronger than their resin counterparts (Chladek et al., 2014; Kreve & Dos Reis, 2019). The plasticized resins last up to 6 months and not more than that (Hashem, 2015). Most of the soft bases are not recommended to be used for above 3 years (Louis et al., 1991). Soft liners can be long-term or short-term. Long-term ones can be used for up to 4 weeks in oral cavity but they are usable for years (Chladek et al., 2014; Singh & Gupta, 2016).

There are some painful and unique conditions which are hard to treat with traditional prosthesis. Due to viscoelasticity and potential to absorb pressure, soft bases are used for even distribution of weight at the time of fiction, avoid pain and improve comfort for the patient (Hashem, 2015). However, soft bases are not easy to use as soft material is not easy to find (Louis et al., 1992). There are multiple cases when soft liners lose their mechanical properties due to ageing, such as flexibility and viscoelasticity, water absorption, changes in dimension, changes in colour and taste, bacterial and fungal infection, adhesion loss between hard and soft base, hardening of surface and cracks (Hashem, 2015).

2.4 Long-term Denture Lining

The "long-term soft denture lining (LTSDL) " consists of polymer materials which can stay in oral cavity for up to 4 weeks but their actual use can last for several months or years. These materials are ideal for edentulous patients who have atrophied or steep alveolar edges, whom mucosa is not capable enough to handle weight from dentures, who have thin atrophic mucosa, and those who have painful areas at nerve ending. It is also used when sore spots are constantly formed under dentures, when dentures don't retain properly, and to reline implantology (Bulad et al., 2004; Mack, 1989; El-Hadary & Drummond, 2000; Saber-Sheikh et al., 1999). The soft material is applied to improve comfort for patients who wear dentures and to help in prosthetic treatment. This type of material can provide even distribution of biting weight transferred over the soft tissues while chewing and to relieve mucosa from heavy stress from mechanical parts (Braden et al, 1995). It is worth noting that long-term lining cannot control the forces from area that bears dentures as it has often suggested (Braden et al, 1995).

Some of the dental materials which are easily available are "acrylic-based long-term soft denture linings (ALTSDLs) ", "silicone-based long-term soft denture linings (SLTSDLs) ", and other polymer-based materials. Polymethacrylate materials are not used widely these days and they come as "2-component powder-liquid systems". The one-component material is SLTSDL which is used to cross-link as "2-paste A-type silicone system" and at high temperature crosslinking at room temperature (Kawano et al., 1992). Some of the common materials that can be used as LTSDLs are "polyphosphazene elastomer" and "light-cured urethane acrylate" which can be compounded with "methacrylate monomers" (Parker et al., 1997).

2.5 Impact of the Long-term soft relining on Elderly Patients

Soft liners are basically the cushions and barriers between the ridge and denture base. So, it becomes vital to know their impact on the surface having mandibular denture. Babu et al. (2017) conducted a study to determine the effect of soft denture liner on resorption of mandibular ridge after 1 year in patients who have permanently worn dentures. The study sample included 28 elderly edentulous patients aged 45 to 60 years having ridges perfectly formed in class 1 jaw. The participants are enrolled with randomization chart in control and experimental groups who got mandibular dentures without and with soft liners, respectively.

Researchers used "orthopantomograph" for conducting vertical measurements and Adobe Photoshop version 7 to analyse the same at 5 points – two points in each region of first molar, two at left and right first premolars, and one at core incisor. When applying "repeated measures analysis of variance", major change is reported by both groups in bone height once denture is placed. The bone level difference was statistically significant up to 6 and 12 months after conducting "intergroup comparison (Wilcoxon rank sum test) of bone height", while there was no statistically significant difference during the periods of 6 and 12 months. The findings suggest that soft liner drastically minimizes

resorption of ridge in patients who wear complete denture in comparison to patients who wear traditional denture for 1 year.

2.6 Impact of the Soft liners on the wearers

Soft liners are basically soft polymers fixed to the fitting area of the denture to distribute occlusal weight or reduce it more evenly on the mucosal tissues. **Kouser et al. (2021)** conducted a study to determine the impact of soft liners based on silicone, acrylic, and traditional denture on patients who wear complete dentures after 6 months and 9 months of getting denture. The study selected 30 elderly edentulous patients aged 45 to 60 years with perfectly-formed ridges in "class I jaw relations". The patients were split into 3 groups of 10 patients each. Traditional dentures were given to Group 1, acrylic dentures were given to second group, and silicone-based one was given to third group.

Researchers used Photoshop 7.0 to analyse vertical measurements taken with "orthopantomograph" at five points – one at core incisor, 2 at left and right premolars, and 2 points in each of the first molar area. There was a significant change in all three groups after delivery of dentures. Group 2 and Group 3 participants lose lesser bone in all areas, while Group 1 lose more bone over 9 months. There was a huge change in bone levels while comparing bone height across three groups in varied areas at several intervals at baseline from 6 to 9 months. Using soft liner drastically reduces resorption of residual ridge in patients who wore complete dentures rather than those who wore traditional dentures without liner for 9 months of insertion.

2.7 Effect of the Surface treatment on the longevity of the soft liners

Proper integrity of the surface and softness are the most vital benefits of tissue conditioner. Singh et al. (2010) examined the impact of surface treatment at various time durations to test the tissue softness and surface integrity. Sample size consists of 72 participants in control and test groups. They were given tissue conditioner which was covered with surface conditioning solution. Durometer was used to test softness in samples and "scanning electron microscope (SEM) " was used at the baseline to test surface integrity.

There was a huge difference between test and control groups as observed in the softness on "American Standards for Testing Materials (ASTM) " scale. SEM analysis has showed that there was a decline in surface quality in patients selected in control group by the end of Week 1, while it remained unchanged by the end of Week 3 in the test group. Applying coating can drastically prevent loss of softness and integrity. Hence, coating may improve work life by preserving surface integrity and softness of conditioner. This way, tissue conditioner can last longer than manufacturer's claim before replacement due to surface coating.

3. Findings and Conclusion

Soft liners have been used for a century in dentistry, even though rubbers were used as soft liners in the past. Soft liners are defined as soft resilient material that is bonded to the denture area where it fits to control stress to nearby tissues, according to ISO in 1999. These materials act as cushioning agents on dentures in edentulous patients. Soft liners are widely used to control stress on local points. Usually, they are cushions and barriers to masticatory pressures from tissues but they don't reduce the transferred force.

Soft liners play a vital role to get rid of prosthodontics due to its impact of cushioning and potential to redistribute masticatory forces which are transferred to the area which bears dentures. The long-term and short-term liners are categorized into silicone-based and acrylic-based materials. It is important to consider mechanical strength, biocompatibility, and durability of soft liners before selecting it. Mechanical and physical issues are common with these materials while applying clinically, for example, loss of resilience and plasticizer, change in colour, porosity, and poor strength of rupture. Modern methods and materials are used these days to deal with these soft liners.

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