APPLICATION OF RESILIENT DENTURE LINING MATERIALS: LITERATURE REVIEW

Mariana Yankova¹, Todor Peev², Bozhidar Yordanov¹, Mariana Dimova-Gabrovska¹, Rangel Todorov¹

1) Department of Prosthetic Dental Medicine, Faculty of Dental Medicine, Medical University – Sofia, Bulgaria.

2) Private Practice – Sofia, Bulgaria

SUMMARY

Clinical cases of excessive bone resorption, presented thin, non-pliable mucosa, exostosis or painful neurogenic points require more specific methods for treatment with removable dentures. Specialized scientific literature discusses various materials and technologies for solving these problems. The use of resilient lining materials (RLMs) for partial and complete dentures is a possible solution if there are clear clinical indications and appropriate selection of the type of material.

The purpose of this review is to provide and analyze up-to-date literature data on the use of resilient materials for partial and complete denture lining.

Material and Methods: An electronic search in PubMed, Google, EBSCOhost and Science Direct databases was conducted from January to December 2019.

Results: Resilient lining materials have a variety of applications. They can be used in complete and all types of partial edentation, i.e. Classes I, II, IV and VI by Kennedy - Popov. The indications for use are different for the two RLMs groups, i.e. temporary (short-term) and permanent (long-term) lining materials. A number of authors have identified them as materials for the limited application. They consider that their use is justified only in the case of the severely atrophied alveolar ridge, in obturators and epitheses.

Conclusion: Resilient lining needs to be considered and planned in advance. It should not be used to compensate for errors in denture design. Appropriate selection of a material for the particular clinical case is of crucial importance.

Keywords: resilient denture lining materials, two-layer denture, use of resilient denture lining materials, temporary (short-term) lining, permanent (long-term) lining

INTRODUCTION:

Clinical cases of excessive bone resorption, presented thin, non-pliable mucosa, exostosis or painful neurogenic points require more specific methods for treatment with partial and complete dentures. Specialized scientific literature discusses various materials and technologies for solving these problems.

Demographic aging is a fact in the world, and Bulgaria is no exception. In a study conducted in Bulgaria in 2000, out of 653 subjects studied, 36.75% needed prosthetic treatment, and 45.5% were dissatisfied with their removable dentures [1]. In 2013, Pavlova, Uzunov and Filchev [2], in a study of 102 dentures, found that 44.9% of them were moderately comfortable. When analyzing the causes, it became clear that denture dislocation and mucosal trauma were the main discomfort-related factors. Objectively, 39.62% of the upper complete dentures traumatized the vestibule with their edges, and 48.98% of the lower dentures injured the alveolar ridge. The construction of a lower denture is one of the most difficult tasks, which has not yet been fully resolved [3].

OBJECTIVE

The purpose of this review is to present and analyze current literature data on the use of resilient materials for the lining of partial and complete dentures.

MATERIALS AND METHODS

From January to December 2019, an electronic search was conducted in PubMed, Google, EBSCOhost and Science Direct databases. The following keywords were used: “resilient/soft denture lining materials”, “two-layer denture”, “use/application of resilient denture lining materials”, “temporary (short-term) lining”, “permanent lining”, “types of denture lining materials”, “rebasings”, “relining”, “Unterfütterung”, “Unterfütterungskunststoff”, “weichbleibend Unterfütterungsmaterial”. The final selection included 57 publications, the data of which were analyzed, summarized and presented in the main body of this review.

RESULTS:

For the resolution of clinical cases requiring more uniform and smooth transmission of masticatory pressure, several authors [4 – 9] recommend the use of resilient lining materials (RLMs).

Abrams in 2000 and later in 2002 [10, 11] described clinical cases of exostosis in the premolar area of the sublingual space and a highly retentive alveolar ridge in the frontal area with a morphological defect, Class IV by Kennedy, resolved by the method of “triple lamina-

tion". It was a question of fabricating a denture when combining three materials: *Ivocap* (Ivoclar-Vivadent Inc., Liechtenstein) for the denture base, *BITEM* thermoplastic material (Thermoplastic Technologies, Newmarket, Ontario, USA) for the elastic denture wings in the problematic areas, lined with *Molloplast B* silicone-based resin (Detax GmbH, Ettlingen, Germany).

Today's resilient lining materials have a variety of applications. They can be used in complete and in all types of partial edentation, i.e. Classes I, II, IV and VI by Kennedy - Popov [12, 13]. The indications for use are different for the two groups of RLMs, i.e. temporary (short-term) and permanent (long-term) lining materials. In 1992, Geering and Kundert [14] defined all resilient materials as materials of limited application. They consider that their use is justified only in the case of the severely atrophied alveolar ridge, in obturators and epitheses. According to them, all resilient materials, regardless of their composition, change their shape, surface structure, and accumulate microorganisms. Marxkors et al. [15] also consider that the use of resilient resins is appropriate only for obturators and epitheses.

A well-made denture loads the underlying mucosa uniformly during the masticatory function. In hypofunction, atrophy is observed, while in hyperfunction, physiological atrophy is supplemented by resorption of the alveolar ridge. This makes the ill-fitting denture even more uncomfortable and inaccurate - the relationship between shape, function and reaction [13, 16].

As early as 1957, Cook proposed three types of denture lining designs: 1. The RLM covers the edge of the denture 2. The RLM does not cover the edge of the denture 3. The RLM is located between the artificial teeth and the denture plate [17].

Indications for the use of temporary (short-term) lining materials

Temporary RLMs can be used as healing liners (tissue conditioners) or as temporary, short-term (up to 6 months) lining materials. Compliance with the indications for use increases the functional value of removable dentures and significantly improves patient comfort.

The advantages of tissue conditioners as therapeutic and diagnostic liners for complete dentures, as well as for taking a functional impression of the prosthetic field are described by a number of authors [4, 6, 18]. Tissue conditioners are cold-curing resilient resins with low final hardness (up to 20 Shore A). Short-term resilient materials are applied through direct (clinical) technique.

When the mucous membrane of the prosthetic field is red, swollen, and inflamed as a result of wearing old uncomfortable dentures, the impression taking is delayed until the tissues are healed. Treatment can take 1-2 weeks and requires that old dentures not be worn during this period. When the patient refuses to stop wearing dentures, there are indications for the use of healing liners. They provide smooth transmission of masticatory pressure, relieve traumatized tissues, and shorten the healing process by using appropriate therapeutic agents [4, 18]. The

patient feels comfortable and does not stop using his/her dentures. Short-term resilient liners are convenient and useful when performing home rebasing for sick and immobile patients [4].

Immediate dentures, fabricated prior to multiple tooth extractions, usually require rebasing after a certain period of time, which can be done with resilient materials. In 1960, Watt [cit. according Jagger and Harrison [18]] examined the changes in the jawbones and found that 40% of post-extraction changes occurred by the end of the first month, 65% by the end of the third month and 80% by the end of the sixth month. After the sixth month, there were no morphological and X-ray differences between new and old bone [19]. It is clear that the fabrication of new permanent dentures after immediate dentures is indicated after sixth months of extraction.

Short-term resilient liners are used for diagnostic purposes in severe cases of complete edentation when a planned change of the complete denture is required [4].

The functional impression is defined as an impression made under a functional load. The material used as a tissue conditioner successfully replaces the functional impression [4, 18, 20, 21]. Dentures, rebased with a resilient material, may remain in the mouth during function (speech and eating). The time described for this procedure is different - from a few minutes [4] to 4 - 6 hours [18]. The functional impression is particularly valuable in patients with congenital and acquired defects. This method can be successfully used in the final design of obturators [22].

Indications for the use of permanent (long-term) lining materials

This group includes heat-curing and cold-curing RLMs. Silicone-based materials are significantly longer lasting. Dentures with resilient acrylic liners have a twice shorter life (1 - 2 years) than conventional dentures made only of hard acrylic resin [23].

For the longer functional period of RLMs, indirect lining techniques are recommended to be used. Permanent (long-term) RLMs are materials with higher final hardness (30 - 45 Shore A). Indications for these materials are described in detail by a number of authors [4 - 6].

Progressive age-related atrophy of the alveolar ridge leads to a reduction in the area of the prosthetic field. Knife-edge atrophic ridge, covered with a thin mucous membrane, can be easily traumatized, especially in patients with para functions [4] and patients with upper complete dentures and natural teeth in the mandible [24]. Resilient lining in these cases may be useful for absorbing and distributing occlusal forces [18, 25, 26].

In some individuals, progressive bone atrophy may lead to superficial exposure to the mental nerve. The use of pre-modeling to alleviate this area and resilient lining reduces pressure on the nerve [18].

The resilient lining is used for retentive maxillary tubers, mandibular sublingual bone protrusions (tori in the premolar region), or myeloid edges covered with a thin, atrophic mucosa [18, 25]. Although recommended

in the literature, consideration should be given to the possible increase in denture volume, especially in the area of the palate behind the maxillary tubers. An alternative approach, in this case, is partial lining [27, 28].

Lining with resilient materials is indicated in patients with congenital and acquired defects, for example, for the fabrication of obturators. The use of resilient materials allows for the involvement of alveolar bone deficiencies to increase retention [22, 29, 30]. Xerostomia is a condition of decreased salivation [31]. It is determined by the salivary flow values of stimulated and unstimulated saliva. The adequate amount of saliva lubricates the prosthetic base and promotes retention, while its lack may lead to a loose denture, which will cause discomfort and pain. Some authors [18, 32, 33] define this condition as an indication for the use of RLMs. On the other hand, the hydrophobic nature of modern lining materials can increase mucosal trauma when the denture does not fit properly.

According to Grant, Heath and McCord [5], resilient liners should not be considered a panacea. They are effective in cortical bone elevations but not in non-cortical sharp formations. The authors do not recommend them in cases of superficial exposure of nervous vascular bundles and xerostomia, unlike Jagger and Harrison [18]. Candidiasis, which is a common feature of edentulous patients with dry mouth, is an additional aggravating factor.

Oral submucosal fibrosis is a chronic, progressive disease with multifactorial etiology, considered a precancerous condition. The disease is associated with edentation and salivary gland hypofunction. To improve denture retention and stability, as well as patient comfort, Gajwani et al. [32] suggest the use of resilient lining materials (RLMs).

An interesting prosthetic solution is suggested by Kaira and Dabral [34]. The prosthetic construction they made is a complete denture with openings for the available teeth, lined with a resilient material. It is fabricated in cases of subtotal tooth loss, with remaining several periodontally compromised teeth, the preservation of which prevents jawbone atrophy, preserves proprioceptive periodontal sensitivity and has a positive psychological effect on the patient. Other authors suggest the same type of denture [35, 36]. It can be fabricated by either direct or indirect technique.

The effect of functional load smoothing is also used in implantology. Rebasing with short-term RLMs during osteogenesis, as well as after the insertion of gingival forming elements, is recommended by a number of authors [37 – 40]. Early load-induced micro-movements (over 150µm) may induce the formation of a fibrous capsule instead of a healthy bone-implant interface [41].

Three-dimensional finite element analysis (3D-FEA) is a widely used method in oral implantology for the digital analysis of stress concentration and bone deformity

near the implant [42]. In 2011, Dos Santos et al. [43] found that resilient lining reduced stress in peri-implant tissues, but due to its qualitative changes, it had to be replaced monthly. Later, in 2013, Dos Santos et al. [44] gave digital values for the anti-stress effect of RLMs. According to them, the reduction of stress in peri-implant tissues was from 2.44 to 4.82 times, depending on the final hardness of the resilient liner. The use of an over-implant, resilient-lined denture as an intermediate (during implant osseointegration) or final construction is described by several authors [45 – 47].

Taira et al. [48] report a 10-year follow-up of an over-implant, lined denture in a case of hemiglossectomy.

Savabi, Ataei, and Khodaeian [49] report the use of RLMs in an over-implant palatal lift denture in paralytic dysarthria. Dysarthria is a speech disorder that can result from a cerebrovascular disorder and is clinically manifested with insufficient closure of the rhinopharynx.

Ectodermal dysplasia is a condition that is characterized by dysplasia of tissues of ectodermal origin - nails, teeth, skin and sometimes, tissues of mesodermal origin. A triad of symptoms characterizes this disease, namely: hypotrichosis, hypodontia/anodontia, and hypohidrosis. In 2012, Kumar et al. [50] reported the development of two-layer complete dentures for a 12-year-old boy with ectodermal dysplasia.

In 2010, Shekhar et al. and other [51, 52] described a clinical case of an 8-year-old girl with ectodermal dysplasia, resolved by making an upper overlay denture and a lower complete denture, lined with *Molloplast B* resilient material (Detax, GmbH & Co, KG, Germany).

In recent years, bisphosphonate-related osteonecrosis of the jaw (BRONJ) has been frequently discussed in patients receiving oral or intravenous bisphosphonates. Prosthetic treatment of such patients should be very careful with regard to possible bone lesions. Göllner et al. [53] report a clinical case of a patient with BRONJ, treated with telescopic supported overlay dentures, lined with a heat-curing resilient material, followed for 2 years.

Retention of complete dentures in highly resorbed alveolar ridges is very difficult. A large group of patients with impossible implant placement use denture adhesives for this purpose [54]. There are literature data on the use of RLMs to improve retention and stabilization of complete dentures. Several authors [55 – 57] report a unique technique to retain complete dentures, the so-called “multi-cup dentures”. These dentures have multiple small suction cups (about 200 for the upper jaw and about 150 for the lower jaw) onto a soft denture liner (Fig. 1). By using a special instrument (Fig. 2), depressions with 2.0 mm diameter and 1.0 mm wall thickness are made on the working model, spaced 1.0 - 1.5 mm apart so that they do not have a common wall.

Fig. 1. Multiple depressions on the maxillary and mandibular model (Chandrakala V. et al., [55])

Fig. 2. The instrument for shaping depressions (Chandrakala V. et al., [55])

Fig. 3. View of the suction cups (relaxed and under pressure) and the angle of the wall (Chandrakala V. et al., [55])

The special cup-shaped instrument gives the suction cups the appearance of an octopus. The ideal depth of the cut in the gypsum is 0.25 mm - 0.38 mm. The shape of the depression is a cone with straight walls and an angle of 12.5° (Fig. 3). The depressions are located 2.0 mm from the edge of the denture and away from the frenulum. When the silicone material is pressed, it enters the depressions, and a number of small suction cups are produced on its surface. This technique is an alternative for uncomfortable and poorly fitting dentures.

CONCLUSION

The resilient lining needs to be considered and planned in advance. It should not be used to compensate for errors in denture design. Knowledge of characteristics of various types of resilient lining materials enables the correct selection of appropriate material for the particular clinical case.

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Please cite this article as: Yankova M, Peev T, Yordanov B, Dimova-Gabrovska M, Todorov R. Application of Resilient Denture Lining Materials: Literature Review. *J of IMAB*. 2021 Apr-Jun;27(2):3676-3681. DOI: <https://doi.org/10.5272/jimab.2021272.3676>

Received: 14/05/2020; Published online: 02/04/2021

Address for correspondence:

Dr Mariana Yankova, PhD

Department of Prosthetic Dental Medicine, Faculty of Dental Medicine, Medical University - Sofia,

1, St. G. Sofiiski Blvd., Sofia, Bulgaria

E-mail: marianayankova13@gmail.com,