

Nonmetal clasp dentures: What is the evidence about their use?

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Abstract

The aim was to discuss the indications, contraindications, advantages, and disadvantages of Nonmetal clasp dentures (NMCDs), as well as the most relevant properties of its constituent materials. A search was conducted using the keywords: “nonmetal clasp dentures,” “thermoplastic resin,” “flexible resin removable partial denture,” “polyamide,” and “nylon” in databases PubMed/Medline, Lilacs, SciELO, and textbooks between 1955 and 2020. Theses and texts without reliable sources of publication were excluded. Once the analysis instruments were determined, the data were analyzed and discussed. NMCDs present high flexibility, easy adaptation to the abutments, color compatibility and biocompatibility with the oral mucosa, and absence of visible metal clasps. However, they need laboratory relining, grinding, and polishing, do not have criteria for its planning, become rougher and stained over time, and are able to traumatize supporting tissues. The association with metal components seems to be an alternative to increase the success of NMCDs by combining esthetics and biomechanical principles of conventional removable partial dentures. The lack of long-term clinical studies makes the professionals to rely solely on previous experiences or on the manufacturers’ recommendations. It suggested that NMCDs must be indicated with caution when not used temporarily.

Keywords: Dental clasps, denture bases, denture design, nylons, removable partial denture


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INTRODUCTION

Nowadays, there is a great tendency of professionals to elaborate a prosthetic planning limited to osseointegrated implants, excluding removable dentures from the rehabilitating possibilities. Removable partial

dentures (RPDs) are still considered a viable and conservative alternative for rehabilitative treatment, resulting in satisfying function and esthetics for patients. Dental preparations for RPDs are considered minimally invasive, and the clinical time required for this treatment is reduced when compared to implant rehabilitation.

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Furthermore, RPDs restore the lost support tissues, recovering lip and facial support to the patient, without the need for surgical interventions.^[1]

Despite the benefits and broad indication of the RPDs, their adequate performance is often impaired due to lack of knowledge of the biomechanical principles and planning by the professional, as well as the lack of communication between the practitioner and the dental technician.^[2] Still, the evidence of metal clasps when smiling^[3,4] and the use of acrylic resin^[5] decrease the users' degree of satisfaction toward these dentures. Another frequent complaint regarding patients' acceptance of RPDs is the discomfort caused by contact between the acrylic base and metal framework with the supporting tissues.^[3,6]

In search of alternative strategies to minimize the undesirable effects of conventional RPDs, since the 1950s,^[7] the nylon-type polyamide resin has been used for manufacturing flexible removable dentures in the USA. Except for artificial teeth, flexible dentures are originally metal-free, and the retainers, connectors, and prosthetic base are made of thermoplastic materials.^[8] Because of its lack of necessary stiffness to the components that provide vertical support to the RPDs, the support of the fully flexible removable dentures depends on the supporting soft tissues, which can be injured if alveolar bone is overloaded.^[9] Therefore, more recently, an association between the RPD metal framework with anterior clasps and thermoplastic denture base has been used.^[10,11] This combination aims to achieve adequate rigidity and vertical support to RPD.^[12]

Due to the variation of the constituent materials of dentures with thermoplastic bases, as mentioned above, the more appropriate term to designate them is "nonmetal clasp denture" (NMCD).^[3] These dentures present better esthetics since their clasps are made of the same material of the prosthetic base, which helps increase the patient's acceptance. However, when inadequately indicated, these dentures can cause greater damage to supportive tissues, including abnormal resorption of the alveolar bone and increased mobility of the abutment teeth.^[3,8] In addition, there are no longitudinal clinical studies in the available literature that prove the success of the treatment with this type of denture. The few available papers regarding NMCDs are either clinical cases without long-term evaluations or *in vitro* studies addressing specific properties of thermoplastic materials. Hence, there is no consensus on the applicability of this modality of RPD. For these reasons, the professional should cautiously indicate the NMCDs.

Considering the lack of long-term clinical studies, as well as systematic reviews addressing NMCD, professionals are frequently relying solely on previous experiences or on manufacturers' recommendations. Therefore, this present textual narrative synthesis aimed to review literature within the last 65 years to summarize the main findings of previous studies on NMCDs relating to their advantages and limitations according to the properties of the constituent materials in order to better guide professionals regarding the clinical applications of these prostheses.

METHODS

The method used in this study was the integrative literature review with the following elaboration steps: identification of the theme, determination of inclusion and exclusion criteria, establishment of databases for the collection of relevant information on the subject, and finally, the reading, interpretation, and discussion of the selected sources.

A comprehensive literature search was performed using the keywords "nonmetal clasp dentures," "thermoplastic resin," "flexible resin removable partial denture," "polyamide," and "nylon," in databases such as Medline, Google Scholar, and textbooks, published between 1955 and 2020, which made reference to the subject. Among all the literature found and after excluding articles with nonrelevant titles and abstracts, only 50 articles were directly related to the topic (flexible resin RPD: 18; thermoplastic resin RPD: 15; nonmetal clasp dentures: 17). These articles were assessed for eligibility, and at this stage, duplicate manuscripts and articles that did not meet the review requirements were excluded. Then, the analysis instruments were determined, and the data were analyzed, organized, and discussed.

In order to guarantee proper readability, findings from the review studies were divided in the following subtopics: indications and contraindications, advantages and disadvantages, and clinical applications.

LITERATURE REVIEW

Indications and contraindications

If proper dental planning is executed, NMCDs are indicated especially to those patients with high esthetic appeal, due to the absence of metallic clasps. Flexible NMCDs are also well indicated as temporary dentures after tooth extraction and implants installation, with the advantage of reducing occlusal overload and improving tissue response,^[13] if provided balanced occlusion and well-adapted bases.^[14] Other indications described in the literature for flexible NMCDs are rehabilitation of only one of the dental arches, in cases of torus or anatomical

accidents that restrict the insertion of a conventional RPD, in patients with acrylic and/or metal allergy,^[14,15] for individuals with a history of recurrent fracture of dentures and users of obturating dentures in patients with partial maxillectomy and palatal cleft.^[13,16] Murthy *et al.*^[17] indicate flexible partial or complete dentures for patients with xerostomia, since the thermoplastic material retains more moisture than conventional acrylic, and also, are more comfortable due to their "flexible" characteristic that offers accommodation on the supporting tissues. The NMCDs with a metallic framework, according to Fueki *et al.*,^[3] can be indicated in almost all cases of partially edentulous arches. This is because they have the esthetics of the thermoplastic resin clasps and greater control of the denture displacement during use due to the rigidity of the major connector and/or vertical support of the metallic occlusal rests.^[12] As a result, these types of dentures may be indicated in cases of absence of posterior occlusal support, such as for patients with distal-extensions arches (Kennedy I and II situations) with several remaining teeth.^[14,18]

In respect to their contraindications, NMCDs with other metallic components are not recommended for patients with few remaining teeth and in situations that impose high levels of stress on resin clasps.^[11,19] For flexible (metal-free) NMCDs, the contraindications are even broader, since the absence of a metallic support causes the clasp to intrude into the marginal gingiva, which can lead to periodontal damage. Moreover, the large displacement caused by their flexible bases on the supporting tissues can lead to lesions to the coating fibromucosa and even acceleration of alveolar ridge resorption.^[9,11] Abutments with short clinical crowns restrict the indication of NMCDs by hindering the adequate design of the esthetic clasp and its position regarding the abutment's prosthetic equator, limiting its retention capacity.^[3,20] Hence, flexible NMCDs should also not be indicated for arches with few direct abutment teeth and when there are large edentulous spaces, which is often observed in free-end saddles, especially in cases of inferior knife-blade alveolar ridge or presence of lingual mandibular torus and superior alveolar ridge with severe atrophy.^[3,20] The presence of few direct abutment teeth results in concentration of forces in the resin clasps, which can deform or fracture, leading to deleterious effects on the remaining teeth and the residual ridge, inducing bone resorption.^[3] In the same way as for conventional RPDs,^[21] NMCDs are contraindicated for patients with poor oral hygiene as well as for those who do not attend the postinstallation controls, since the biofilm formed around the abutments can cause or exacerbate pathologies such as caries and periodontal disease.

Advantages and disadvantages

When comparing the conventional RPDs to NMCDs, the latter present some advantages, such as the greater biocompatibility of the thermoplastic resin with the tissues of the buccal cavity due to the lack of residual monomer as in the PMMA resin.^[3,22] The polyamide resin owns a lower modulus of elasticity than the acrylic resin, which reflects in the sensation of a better smoothness reported by the patients and ensures a lower risk of fracture to NMCDs.^[3,19,23] Besides being safe for patients allergic to metallic components,^[14,15,24] metal-free NMCDs present great adaptation to the movements of the buccal cavity and support tissues, especially if treated quickly in hot water, and eliminate the need to prepare the supporting teeth to receive any metallic rest, preserving sound tooth structure.^[20,25] Furthermore, it has been reported that when used temporarily, flexible NMCDs promote better tissue response to supportive fibromucosa than conventional temporary RPDs.^[26]

Even when combined with a metal framework, the flexibility of the NMCDs allows good retention added to the advantage of not needing many modifications in the abutment teeth.^[27] The thermoplastic resins allow greater versatility of dentures design^[25] and ease of execution of an esthetic planning. Their good esthetics are achieved due to the material's transparent appearance, properly evidencing the tone of adjacent gingival tissues, dispensing the characterizing acrylization laboratory stage.^[28]

In respect to the disadvantages of NMCDs, its greater degradation and discoloration over time have been reported in comparison with conventional RPDs.^[28,29] In the oral environment, the thermoplastic resin, when compared with the acrylic one, becomes more roughed, favoring biofilm accumulation as well as absorbing more fluids, which makes the material more prone to staining.^[27] *In vitro* studies have been performed to evaluate the color stability^[5,28-31] and the roughness^[27,31-33] of thermoplastic materials for NMCDs. The staining of the thermoplastic resin in the buccal environment should be considered by the possible interference with the esthetics of NMCDs, which is one of the most relevant characteristics. Thus, it has been suggested that color stability of the thermoplastic materials still needs to be improved.^[29] Likewise, roughness is directly and indirectly associated with several other factors, such as staining, discomfort to the patient and biofilm accumulation, which can favor the development of oral lesions such as denture stomatitis.^[30,31]

Still as a disadvantage, NMCDs present higher laboratory cost compared to conventional RPDs, and there are still

few prosthetic laboratories with proper technology for their preparation.^[3,19] As mentioned earlier, the flexible NMCDs do not have some important mechanical elements of the conventional RPDs, such as occlusal rests and major metallic connectors,^[10] so it is not prudent to indicate them as a definitive treatment.^[29]

Clinical applications

Some clinical reports are available in relevant literature regarding rehabilitation of patients with NMCDs.^[1,9,15,25,34-36] The clinical report described by Boral *et al.*^[36] shows the rehabilitation with flexible NMCDs in a patient with upper and lower partially edentulous arches, both Kennedy Class III with no modifications. According to the authors, rehabilitation presented good retention and esthetics, being considered comfortable by the patient, mainly due to the lower weight compared to the conventional RPD.

Clinical reports show the NMCD as a treatment alternative for a patient who underwent surgery to remove odontogenic keratocysts,^[25] in case of hemiglossectomy,^[1] immediate rehabilitation,^[34] pediatric patients who early lost primary teeth or in cases of genetic diseases, such as ectodermal dysplasia.^[35] In the relevant literature, only one clinical case report on NMCD with subsequent follow-up was found.^[10] In this study, the patient, who used a lower conventional RPD (Class II modification 1), complained about the appearance of the anterior metal clasp during smile. Among the types of rehabilitation offered by dentists (RPDs with attachments, implant-supported dentures and NMCD), the patient chose a NMCD for economic reasons and shorter treatment time. The authors planned a NMCD combined with conventional RPD, in which the anterior clasps were made of nylon polyamide of the prosthetic base attached to the metallic framework formed by the major connector, posterior clasps, and occlusal rests. During the patient's 2-year follow-up after the installation of the modified NMCD, the nylon base showed superficial discoloration, but the gingival tissues of the anterior teeth with esthetic clasps did not show evidence of inflammation. According to the authors, polyamide clasps appeared to be functional regarding retention in the assessed period, and the observed loss of reciprocity was not shown to be a problem since there was no evidence of excessive mobility of the abutments.^[10]

In a single-center, randomized controlled, two-phase, open-label, cross-over trial, Fueki *et al.*^[37] investigated the efficacy of NMCDs with a framework regarding the oral health-related quality of life (OHRQoL), comparing the results with those for conventional metal clasp-retained dentures (RDP). During 3 months, patients

were randomized to receive RDPs followed by NMCDs or the opposite sequence ($n = 14/\text{group}$). Their results suggested advantages of NMCDs over RDPs with regard to OHRQoL. However, since patients were evaluated for only 3 months with each denture, the authors stated the necessity of clinical researches with longer follow-up durations to estimate more reliable effects.^[38]

DISCUSSION

This study provided, through a detailed survey of the related scientific literature, an insight into the limitations and advantages of NMCDs for their clinic applications by professionals, especially considering the lack of long-term clinical studies on these prostheses.

Nonmetallic clasp removable dentures have been considered an option to conventional treatment with RPDs with great acceptance by patients who claim for better esthetics and low cost.^[39-41] NMCDs are also indicated for those individuals who, for financial reasons or health conditions, cannot receive treatment with dental implants.^[3] Thermoplastic resins exhibit biocompatibility with oral tissues and good moisture retention capacity, which makes NMCDs suitable for individuals with PMMA resin allergy and xerostomic patients.^[14,15,27] The high resilience of NMCDs increases fracture strength and comfort sensation, especially benefiting patients with a history of recurrent fracture of rigid acrylic bases and those intolerant to them.^[25]

Despite the advantages of NMCDs, some limitations and contraindications to its use should be considered in addition to those related to conventional RPDs, such as for patients with poor oral hygiene and/or reluctance to commit to the posterior control phase.^[21] Furthermore, attention must be given to abutment teeth with short clinical crowns, once retention of esthetic clasps could be lost due to changes in the design and position of the retainers. Flexible NMCDs are also not recommended for Kennedy Class I and II rehabilitations, which require periodic relining of their bases since the thermoplastic material does not present adequate bonding to the relined resins, requiring special laboratory procedures.^[42] These dentures still have limited use in cases involving extensive areas of tissue coverage by the thermoplastic base since their grinding and polishing at chairside are not satisfactory.^[39] Although the thermoplastic resin adaptation to the supporting tissues is superior to that of PMMA resin due to its injection technique,^[43] many laboratory errors may occur in this process, especially regarding clasps that may lose their retentive capacity.^[13]

Taking these considerations into account, it is imperative to carefully evaluate the clinical conditions of each patient to indicate NMCDs correctly, since there is no consensus as to whether they can function as definitive rehabilitations or should only be used as temporary dentures.^[15,25,26,44] In this sense, it is important to consider whether the NMCD will be made entirely by thermoplastic resin, except for artificial teeth, or if this material will be combined with some metallic framework, e.g., occlusal supports and connectors.^[36]

Flexible NMCDs are safely prescribed as temporary dentures after exodontia or implant placement by minimizing occlusal overload^[26] and favoring supporting fibromucosa response when compared to conventional temporary acrylic-based RPDs and orthodontic wire clasps.^[13] Pediatric patients with early loss of primary teeth or anomalies, such as ectodermal dysplasia, may also benefit from flexible NMCDs. In such cases, where implant placement is not suggested, these flexible dentures are a reversible and esthetic treatment alternative because the thermoplastic resin resilience fits better to the child's oral changes during its growth phase compared to conventional provisional RPDs.^[36]

There are some clinical reports in literature addressing the application of metal-free NMCDs in patients who underwent surgical treatment to remove odontogenic tumors^[35] or oral cancer.^[1] In the majority of the published clinical reports,^[1,9,15,25,36,37,45] rehabilitations with flexible NMCDs were performed in arches with wide spaces and distal extensions, but none of the available reports described the long-term follow-up of these patients. The absence of metallic supports in these dentures causes the clasps to reach the marginal gingiva of the abutments, which may compromise their periodontium. For these reasons, it has been suggested that flexible NMCDs should be indicated for esthetic reasons only temporarily in postsurgical cases in order to minimize a possible overload.^[26]

Even with rigid components, the combined NMCDs allow greater planning versatility in relation to conventional RPDs, especially regarding obtaining the insertion and removal axis and preparation of the anterior axial surfaces.^[10] Despite this greater indication ease, such dentures are not indicated in cases where there is no posterior occlusal support since its resilience makes it difficult to maintain the occlusal vertical dimension.^[14,18] Likewise, patients with few remaining teeth and in other situations that overload the resin clasps should not be rehabilitated with these flexible dentures.^[3,20]

The susceptibility of thermoplastic resins to staining and discoloration, especially the polyamide ones, has been related to their higher liquid sorption capacity,^[44] to the oxidation promoted by the amine accelerator and to the difficulty in conducting polishing procedures of the prosthetic base.^[5] The literature suggests that the nylon surface is more easily colonized by *Candida* species than that of PMMA,^[30] which could clinically favor the appearance of pathologies, e.g., prosthetic stomatitis.^[30] It has been reported that thermoplastic resins exhibit lower flexural strength,^[46-49] elasticity modulus,^[46] and hardness^[47] in relation to heat-curing PMMA resin. Even when surface was treated with silica^[34,46] and 4-META/MMA-TBB^[46] resin, thermoplastic resins present great difficulty at bonding to the acrylic reliner, suggesting that relining procedures should only be performed in laboratory. This is also valid for conventional fitting and polishing procedures that can overheat the thermoplastic resin without promoting adequate surface smoothness; hence, they should be conducted using proper cooling systems and special equipment in the laboratory.^[27]

As previously reported, the available studies on NMCDs are mainly *in vitro* studies on thermoplastic materials, clinical reports, and authors' opinions, which are low clinical relevance studies. Although recent clinical studies have suggested that NMCDs with a framework allow for better OHRQoL compared with MCDs, the follow-up was just with one month^[50] or the patients wore each type of denture only for 3 months.^[38] Therefore, the development of new controlled clinical and laboratory studies, as well as long-term clinical follow-up in order to better clarify the performance of NMCDs in the oral cavity, are essential, so that the professional can prescribe this alternative rehabilitative treatment with greater clarity.

CONCLUSIONS

Considering the limited bibliographical references in current literature on NMCDs, it is suggested that their use to be restricted to Kennedy's Class III partially edentulous arch with several remaining teeth, patients after surgical intervention, and those allergic to PMMA and/or metal. When NMCDs are combined with metallic framework, the benefits increase, as well as the possibilities of using them when esthetics is essential for the patient. However, even when these flexible prostheses are well prescribed, the patient should always be properly informed about their limitations, such as greater color change over time compared to the conventional RPDs and impossibility to be relined, which makes them provisionally indicated. Moreover, patients need to be warned by professionals

regarding the loss of thermal sensations when consuming hot or cold foods due to the absence of the metal in these prostheses.

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Conflicts of interest

There are no conflicts of interest.

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