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Review

Flexible Dentures: Materials, Properties, and Patients Satisfaction

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Abstract

Tooth loss, stemming from a variety of causes such as trauma, dental decay, gum diseases, and oral pathologies, extends its impact beyond physical discomfort, infiltrating psychological, functional, and aesthetic realms. Modern advances in dentistry provide an array of solutions for restoring partially edentulous mouths, tailored to individual patient needs. Options encompass removable partial dentures (RPDs), fixed bridges, and dental implants, each offering distinct advantages. RPDs, while a cost-effective choice, may face limitations with metal-based solutions due to poor mechanical properties and insertion challenges in undercut areas. Acrylic-based RPDs, while economical, can pose discomfort over time, failing to adapt to mouth contours. Flexible dentures however are a comfortable, adaptable alternative crafted from flexible thermoplastic materials like polyamides. These materials deliver strength, aesthetics, and biocompatibility, enhancing patient comfort and providing a natural appearance. This study taps into prominent medical databases like PubMed, Web of Science, and Cochrane, utilizing an extensive range of medical terminology combinations to yield insights valuable to dental professionals and researchers. The flexible denture materials, particularly polyamides, present a pioneering avenue for prosthodontics, delivering a fusion of strength and aesthetics. Characteristics like high creep resistance and solvent resistance confer wear resistance and strength, counterbalanced by challenges related to absorbency and thermal expansion. Patient satisfaction studies favor flexible dentures for functional comfort and cleaning, even though aesthetics exhibit varying perceptions, with some patients favoring their translucency and adaptability, while others express a preference for acrylic dentures.

Keywords: *Polyamides, Flexible denture, Prosthodontics, Patient satisfaction*

Introduction

Tooth loss is a multifaceted issue that can be attributed to various factors, including traumatic incidents, dental cavities (caries), gum diseases, and other oral pathologies. The consequences of losing one or more natural teeth go beyond mere physical discomfort; they encompass psychological, functional, and aesthetic aspects of an individual's life (1). This dental condition can have profound effects on a person's overall well-being, affecting their psychological health, facial aesthetics, phonetic abilities, and the functional aspects of their bite or occlusion (1). One of the immediate consequences of tooth loss is the impairment of oral function. The loss of teeth can make chewing and biting more challenging, potentially leading to difficulties in maintaining a balanced diet (2). This, in turn, can have significant implications for overall nutrition and health. Proper mastication is essential for effective digestion, and its disruption can lead to nutritional deficiencies and related health issues. Furthermore, speech can be affected when natural teeth are missing. Pronunciation difficulties can arise due to the altered oral dynamics, impacting an individual's ability to communicate clearly (2). Speech plays a pivotal role in personal and professional interactions, and any impediment can have social and psychological consequences. The aesthetic aspects of tooth loss cannot be overlooked. Missing teeth can result in noticeable changes to one's facial appearance, such as sunken cheeks or a sagging jawline (3). These alterations may have a profound impact on an individual's self-esteem and confidence. The visible gaps left by missing teeth can be a constant source of self-consciousness, affecting social interactions and self-image (3). Fortunately, modern dentistry offers a range of effective solutions for the restoration of partially edentulous mouths. These solutions cater to the individual needs and preferences of patients, addressing their specific dental and oral health challenges. The primary options include removable partial dentures (RPDs), fixed bridges, and dental implants (4). The choice of prosthesis depends on factors such as the number and location of missing teeth, the condition of adjacent teeth, and the patient's oral health goals. Dental crowns and bridges, for instance, are used to cover or replace teeth that have sustained structural damage and can no longer withstand normal mechanical forces. Crowns can also be utilized to restore a single missing tooth by being placed over a dental implant, thus providing both aesthetic and functional benefits (1, 5). Conversely, dental bridges comprise artificial teeth (pontics) held in place by crowns affixed to adjacent natural teeth or dental implants, making them a reliable solution for replacing multiple adjacent missing teeth (5). Dental implants, inserted into the jawbone through a surgical procedure, serve as a stable foundation for supporting crowns, bridges, or comprehensive arch restorations. For individuals who are concerned about cost or prefer a removable dental solution, partial dentures offer a practical alternative (5). One of the main materials used in the fabrication of definitive cast RPDs is Chromium Cobalt (CrCo) alloy which has been widely used since 1929 (6). These RPDs have a metal framework for strength and durability. They are less bulky and provide a more stable fit. However, metallic dentures have the disadvantage of poor mechanical property, and difficulty with insertion in undercut areas (6). Another alternative for cast metal RPDs are acrylic RPDs. These RPDs are made entirely of acrylic material and are typically less expensive (7). Acrylic resins are frequently utilized because of their satisfactory esthetics and desirable properties such as ease of handling, good thermal conductivity, low permeability to oral fluids, and color stability (7). Since proper fit and comfort are the most crucial and essential requirements of an RPD, the bulkiness of acrylic makes the denture uncomfortable and less suited to the shape of the mouth over time (7).

Flexible dentures are an appealing alternative to conventional rigid dentures, offering a more comfortable and adaptable fit within the oral cavity (8). Made from flexible thermoplastic materials, these dentures provide a personalized and comfortable solution for those with partial tooth loss. Unlike traditional dentures with visible metal clasps, flexible dentures have no metallic components, enhancing both comfort and aesthetics (8). This makes them a particularly attractive choice

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for individuals who may be allergic to acrylic or have sensitive gums. In the case of flexible dentures, their inherent flexibility allows them to conform to the unique contours of the mouth, ensuring a comfortable and secure fit (9). The thermoplastic material is also known for its durability and biocompatibility, reducing the risk of allergic reactions or irritations in the mouth. Moreover, its translucency enables it to blend seamlessly with the natural oral tissues, making the dentures nearly indistinguishable when worn (9).

The rationale for conducting a review study on flexible dentures stems from the increasing prevalence of partial tooth loss and the growing demand for effective, comfortable, and aesthetically pleasing solutions to address this issue. In recent years, flexible dentures have emerged as an innovative and promising alternative to traditional rigid denture materials. However, the scientific literature on flexible dentures is still evolving, and there is a need to consolidate and critically assess the existing research on the materials used their properties, and the satisfaction levels of patients who have received these prosthetic devices. This review study aims to provide a comprehensive and evidence-based analysis of flexible dentures, with a specific focus on three main aspects: flexible denture materials, their properties, and literature regarding patient satisfaction. The findings will be valuable for dental professionals, prosthodontists, and researchers in the field of dentistry, providing insights into the advantages and limitations of flexible dentures and guiding the development of future prosthetic solutions to address partial tooth loss effectively while enhancing patient satisfaction and oral health. Ultimately, this study aims to promote evidence-based decision-making and contribute to the ongoing advancement of dental prosthodontics.

Methods

The research, which commenced on October 31, 2023, was initiated following an extensive review of existing literature. Several databases, including PubMed, Web of Science, and Cochrane, were utilized for this literature survey. The search process involved the use of a wide range of combinations of medical terminology. Furthermore, manual searches on Google Scholar were conducted to identify relevant research terms. The primary objective of this literature review focused on several key areas, such as the materials employed in the creation of flexible dentures, their characteristics, and the satisfaction levels of patients. Keywords related to thermoplastic dental materials, as well as the fit and comfort of flexible dentures, were also incorporated into the search. It's important to note that the selection of articles for inclusion in this study was guided by multiple criteria, ensuring a comprehensive and robust review process.

Discussion

Materials

Flexible dentures are most commonly composed of nylon-like material, replacing the conventional metal alloy, or PMMA for the development of RPD (8). The flexible denture material excels in strength, as well as esthetics, making it one of the most user friendly dental materials for the fabrication of partial dentures (8). The most commonly used material for flexible dentures is polyamides, commonly available as Valplast (7). These materials have gained popularity in the field of prosthodontics due to their unique properties. Polyamides are a type of nylon thermoplastic that is known for its flexibility, comfort, and durability. Valplast dentures are biocompatible and have a natural appearance, making them a popular choice for patients seeking an aesthetically pleasing and comfortable prosthesis (7). Flexite is a brand of flexible denture material made from a proprietary blend of thermoplastic resins. It is known for its ease of adjustment, allowing for a precise fit (10). Flexite dentures are also designed to be aesthetically pleasing and comfortable for wearers (10). Biosens, another variant of polyamides, is a newer entrant in the field of flexible denture materials (11). It is a biocompatible thermoplastic resin that offers flexibility, strength, and resistance to fracture. Biosens dentures are designed to provide both durability and a natural appearance (11). Supernumerary Thermoplastics: Some other thermoplastic materials are used for flexible

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dentures, such as Duraflex, Lucitone, and SR Ivocap (8). Flexible denture materials are chosen for their flexibility, which allows the denture to adapt to the shape of the mouth, providing comfort and a secure fit. Additionally, these materials are less likely to cause allergic reactions or irritations in the mouth, making them suitable for a wide range of patients. The translucency of these materials also contributes to their aesthetic appeal, as they can blend seamlessly with the natural oral tissues, making the dentures less noticeable when worn. These materials, mainly made up of polyamides, have specific compositions that make them suitable for use in dental prosthetics. While the exact formulations may vary between manufacturers, the general composition typically includes thermoplastic resins, fillers, plasticizers, colorants, stabilizers, and biocompatible additives (11). The goal of this composition is to provide a material that is comfortable, durable, aesthetically pleasing, and safe for use in dental applications (10).

Properties

The nylon-based flexible denture materials such as polyamides are stable and are resistant to polymer unzipping which is common in PMMA (12). Resistance to fracture is one of the most important properties of polyamides, however other physical attributes and characteristics vary depending on the brand and its composition (7). High creep resistance and solvent resistance are also found in polyamides, making them wear resistant and high-strength materials (12). Polyamides although have higher absorbency, and undergo high thermal expansion as compared to PMMA (13-15), the material is still preferred due to no porosity and higher dimensional stability (12). Despite having commendable properties, polyamides and other nylon based denture materials are known for notorious staining due to its hydrophilic nature as compared to hydrophobic materials (16). A study comparing three different types of thermoplastic resin materials (polyamide, polycarbonate, and polyethylene terephthalate) observed that polycarbonate resin had the best color stability among the three tested materials, suggesting the need to improve color stability in polyamides (13). Multiple studies also investigated the impact of denture cleaners on the color changing or staining of the polyamide denture base, however no such significant stains were observed (17, 18). Flexural strength and modulus are crucial indicators for the selection of denture base material, and polyamide is reported to have excellent flexural strength and modulus (19, 20). A study comparing flexural strength in PMMA and polyamide (Valplast) reported that exceptionally higher flexural strength was observed in the polyamide as compared to PMMA (21). However, another piece of evidence suggested that polyamides may have higher flexural strength, but their flexural modulus was found to be lower than that of compression molded PMMA (22). However, the flexural strength and modulus of polyamides has been seen to vary among different brand compositions such as Valplast and Sunflex (23). The surface roughness of Valplast dentures can be affected by the manufacturing process. During the injection molding of the thermoplastic material, the surface of the denture base can develop a degree of roughness (17). Manufacturers aim to achieve a balance between flexibility and surface smoothness. Over time, as the Valplast denture is worn, the surface can experience wear and abrasion. The surface texture of Valplast dentures can also influence oral hygiene. A smoother surface is easier to clean and less likely to harbor bacteria and debris. Patients can maintain better oral health with a denture that has a smooth surface (24)

Patient Satisfaction

Studies related to patient satisfaction usually compare different types of denture base materials to evaluate the satisfaction level of patients based on multiple factors such as aesthetics, cleaning, and functional comfort. Evidence suggests that patients with missing tooth were overall more comfortable using flexible dentures as compared to using acrylic or metal RPDs (25). In terms of aesthetics, acrylic dentures were preferred, however, for cleaning and functional comfort flexible dentures were far more praised (25). Another study highlighted contradictory results regarding the aesthetical appearance of flexible dentures and reported that the study participants preferred them over acrylic

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dentures for aesthetic reasons (26). This result can be interpreted due to the higher translucency of the dentures which can reflect the underlying tissue shade with thin translucent clasps. Higher fracture frequency was noted in acrylic dentures as compared to flexible (26). Mucosal changes and denture adaptability were also compromised in patients using acrylic dentures, however, were found to be unchanged for those who were using flexible dentures (27).

Conclusion

In the realm of dental prosthodontics, the introduction of flexible denture materials, primarily composed of polyamides, has revolutionized the development of removable partial dentures (RPDs). Polyamides offer an appealing combination of strength and aesthetics, making them exceptionally user-friendly for crafting partial dentures. Patients appreciate their flexibility, comfort, and durability, as well as their biocompatibility and natural appearance. While polyamides exhibit impressive resistance to fracture, their properties can vary by brand, requiring consideration of specific attributes. They are highly resistant to wear and solvents but may stain due to their hydrophilic nature, prompting the need for ongoing improvements in color stability. Patient satisfaction studies consistently highlight the superior functional comfort and ease of cleaning with flexible dentures compared to acrylic or metal RPDs. Aesthetic preferences vary, with some favoring the translucency and adaptability of flexible dentures, while others prefer acrylic options. In conclusion, flexible denture materials represent a promising advancement in prosthodontics, offering a more comfortable and aesthetically pleasing choice for individuals seeking partial denture solutions.

Disclosure

Conflict of interest

There is no conflict of interest

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Data availability

Data that support the findings of this study are embedded within the manuscript.

Author contribution

All authors contributed to conceptualizing, data drafting, collection and final writing of the manuscript.

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