

TECHNICAL COMPLICATIONS OF REMOVABLE PARTIAL DENTURES IN PARTIALLY EDENTULOUS PATIENTS: INFLUENCE OF BIOMATERIALS AND PROSTHETIC DESIGN – A LITERATURE REVIEW

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ABSTRACT

Removable partial dentures (RPDs) remain one of the most frequently used treatment modalities for the rehabilitation of partially edentulous patients. Their popularity is attributed to affordability, clinical versatility, and the possibility of restoring function and esthetics without extensive surgical procedures. Despite continuous improvements in dental biomaterials and prosthetic design, technical complications remain a major factor affecting the long-term success of treatment. Fracture of denture bases, clasp deformation or fracture, loss of retention, connector failures, and material fatigue are among the most frequently reported complications. The occurrence of these failures is influenced by material properties, framework design, biomechanical loading, and maintenance protocols. This review aims to analyze the most common technical complications associated with removable partial dentures and to evaluate the role of biomaterials and prosthetic design in their prevention and management.

Keywords: removable partial denture, partial edentulism, technical complications, acrylic denture, biomaterials, prosthetic design, retention, denture fracture.

1. Introduction

Partial edentulism continues to represent a significant oral health problem worldwide and frequently requires prosthetic rehabilitation to restore mastication, phonetics, esthetics, and quality of life. Among the available treatment options, removable partial dentures remain widely used because of their relatively low cost and broad range of clinical indications [1].

Although RPDs provide satisfactory functional outcomes, their long-term performance is often affected by technical complications that may compromise patient comfort, prosthesis longevity, and treatment success. The frequency of these complications is influenced by multiple factors, including the choice of biomaterials, prosthetic design, fabrication techniques, and patient-related variables [2].

Recent advances in prosthodontics have introduced novel materials and design concepts aimed at reducing technical failures and improving clinical outcomes. Understanding the relationship between biomaterials, prosthetic design, and complication rates is therefore essential for successful treatment planning.

2. Conventional Acrylic Removable Partial Dentures

Conventional acrylic removable partial dentures represent one of the oldest and most commonly used prosthetic solutions for partially edentulous patients. Their widespread use is mainly due to low manufacturing costs, ease of repair, acceptable esthetics, and relatively simple laboratory procedures [1].

Acrylic partial dentures are frequently indicated as interim prostheses, transitional restorations, or definitive treatment options in patients with financial limitations. Despite these advantages, acrylic prostheses exhibit several limitations, including increased bulk, reduced rigidity, susceptibility to fracture, and progressive loss of adaptation over time [3].

Clinical studies have consistently reported that fracture of acrylic denture bases represents one of the most common technical complications associated with removable prosthodontics [3,4].

3. Denture Base Materials and Contemporary Biomaterials

3.1 Polymethyl Methacrylate (PMMA)

Polymethyl methacrylate remains the most commonly used material for the fabrication of acrylic denture bases because of its favorable esthetic properties, ease of processing, biocompatibility, and dimensional stability [3].

However, PMMA possesses relatively low impact strength and limited resistance to fatigue loading, making fractures a common clinical problem [4].

3.2 High-Impact Acrylic Resins

To improve mechanical performance, reinforced acrylic resins have been developed. Praveen et al. demonstrated significantly greater impact strength in reinforced acrylic materials such as Lucitone 199 and Trevalon when compared with conventional acrylic resins [3].

These materials showed improved resistance to crack propagation and a lower tendency toward catastrophic fracture.

3.3 Thermoplastic Polyamide Resins

Flexible thermoplastic materials, including polyamide-based systems such as Valplast, have become increasingly popular due to their superior esthetics and flexibility [1].

The absence of visible metal clasps and improved patient comfort represent important advantages. Nevertheless, concerns remain regarding long-term dimensional stability and repairability.

3.4 Acetal Resins and Biodentaplast

Acetal-based materials such as Biodentaplast exhibit favorable biomechanical properties, including resilience, elasticity, and resistance to chemical degradation [1].

According to Gradinaru et al., these materials provide excellent esthetics and allow the fabrication of flexible clasps that minimize stress on abutment teeth [1].

4. Technical Complications of Removable Partial Dentures

4.1 Denture Base Fracture

Denture base fracture remains one of the most frequently encountered technical failures.

The principal causes include:

- low impact resistance of acrylic materials;
- cyclic fatigue loading;
- residual internal stresses;
- processing defects and porosities;
- inadequate stress distribution.

Praveen et al. reported significantly higher impact strength in reinforced acrylic resins, suggesting that material selection plays a decisive role in reducing fracture incidence [3].

Systematic reviews have identified fractures of acrylic bases among the most commonly reported technical complications during long-term follow-up of RPDs.

4.2 Clasp Fracture and Deformation

Retentive clasps are continuously subjected to repetitive insertion and removal forces. Over time, metal fatigue may lead to deformation or fracture.

Clinical reports indicate that clasp fractures occur most frequently in distal extension prostheses and in designs involving short retentive clasp arms.

Repeated adjustments and improper clasp design may further increase fracture risk.

4.3 Loss of Retention

Loss of retention is one of the main reasons for patient dissatisfaction and prosthesis replacement.

Contributing factors include:

- clasp deformation;
- wear of retentive components;
- tissue changes;
- poor framework adaptation;
- inadequate guide-plane design.

Mothopi-Peri and Owen demonstrated that guide planes substantially improve prosthesis retention. The presence of guide planes increased retention by approximately 1.6 times, while intimate contact between guide planes and guiding surfaces resulted in more than a tenfold increase in retention force [2].

4.4 Connector-Related Complications

Major connectors play a critical role in maintaining framework rigidity and distributing occlusal forces.

Poor connector design may lead to:

- excessive framework flexure;
- stress concentration;
- speech impairment;
- patient discomfort;
- connector fracture.

Gradinaru et al. emphasized that biomechanical efficiency must be balanced with patient comfort when selecting connector designs [1].

4.5 Denture Tooth Fracture and Wear

Several long-term studies have reported fracture of artificial teeth and veneering materials among the most frequent technical complications associated with removable prostheses.

Excessive occlusal loading, parafunctional habits, and material wear contribute significantly to these failures.

4.6 Relining and Maintenance Requirements

Changes in the supporting tissues over time frequently necessitate relining procedures to restore stability and support.

Failure to perform maintenance procedures may accelerate the development of other technical complications, including fracture and retention loss.

5. Influence of Prosthetic Design on Long-Term Success

The biomechanical design of an RPD is as important as the materials used for its fabrication.

Guide Planes

Guide planes improve retention, stability, and control of the insertion path. Properly designed guide planes reduce horizontal displacement and enhance force distribution [2].

Major Connectors

Major connectors should provide adequate rigidity while minimizing interference with speech and oral function [1].

Occlusal Rests

Occlusal rests prevent tissue-ward displacement and reduce excessive loading of the mucosal tissues.

Stress Distribution

Proper framework design contributes to balanced load transmission and decreases the risk of fracture and deformation [10].

6. Discussion

The literature demonstrates that technical complications in removable partial dentures arise from a complex interaction between biomaterials, prosthetic design, and functional loading.

Conventional acrylic dentures remain highly popular because of their affordability and ease of fabrication; however, their susceptibility to fracture continues to represent a major limitation. Reinforced acrylic resins and thermoplastic materials have improved mechanical performance and patient acceptance, but no material completely eliminates the risk of technical failure.

The findings of Mothopi-Peri and Owen highlight the importance of guide-plane retention in improving prosthesis stability and reducing retention-related complications [2]. Similarly, Gradinaru et al. demonstrated that appropriate selection of biomaterials and connector architecture significantly influences patient satisfaction and prosthetic longevity [1].

Recent systematic evidence suggests that loss of retention, framework fractures, acrylic base

fractures, and denture tooth fractures remain the most frequently reported technical complications regardless of the retention system employed.

Consequently, successful rehabilitation requires an individualized treatment approach that combines appropriate biomaterial selection with sound biomechanical design principles.

7. Conclusions

1. Technical complications remain a major factor limiting the long-term success of removable partial dentures.
2. Denture base fractures, clasp failures, loss of retention, connector-related complications, and denture tooth fractures are among the most frequently encountered technical problems.
3. The choice of biomaterials significantly influences prosthesis durability and resistance to mechanical failure.
4. Reinforced acrylic resins, thermoplastic polymers, and acetal resins offer promising improvements compared with conventional acrylic materials.
5. Proper prosthetic design, particularly regarding guide planes, occlusal rests, and major connectors, plays a fundamental role in improving retention and biomechanical stability.
6. Long-term success depends on the combined optimization of biomaterials, prosthetic design, and maintenance protocols.

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