

RISK FACTORS IN FIXED AND REMOVABLE PROSTHETIC THERAPY: A NARRATIVE REVIEW

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Abstract

Objectives. The aim of this narrative review was to identify and evaluate the main risk factors influencing the outcomes of fixed and removable prosthetic therapy, encompassing both biological and mechanical determinants, patient-related variables, and clinical management factors across the principal prosthetic modalities. **Materials and Methods.** A structured literature search was conducted in PubMed/MEDLINE, PubMed Central, Scopus, and Web of Science. Systematic reviews, meta-analyses, randomized controlled trials, and cohort studies published between 2000 and 2025 were included. Outcomes of interest were prosthetic survival rate, prosthetic success rate, biological and mechanical complication rates, abutment tooth loss, marginal bone loss in implant-supported restorations, and patient-reported outcomes. Data were synthesized narratively due to heterogeneity across included studies. **Results.** Risk factors in prosthetic therapy operate at multiple levels: patient-related factors — including systemic disease, parafunctional habits, oral hygiene, and smoking — interact with treatment-related variables such as prosthetic design, material selection, occlusal loading, and abutment tooth condition. Biological complications, including caries, periodontal disease, and pulpal pathology, represent the leading cause of abutment tooth loss and fixed prosthesis failure, while mechanical complications — fracture, debonding, and wear — are predominantly material- and design-dependent. In removable prosthetics, mucosal health, residual ridge resorption, and denture hygiene emerge as the principal determinants of long-term outcomes. **Conclusions.** Risk factor identification and stratification prior to prosthetic treatment planning is essential for optimizing long-term outcomes. A multidisciplinary, patient-centered approach that addresses modifiable risk factors before and throughout prosthetic rehabilitation remains the most effective strategy for improving treatment predictability in both fixed and removable prosthetic therapy.

Keywords: risk factors; failure; prosthetic therapy; fixed; removable

1. INTRODUCTION

The worldwide prevalence of extensive partial or complete edentulism ranges between 1% and 5% [1]. Edentulism can lead to functional, physical, and physiological limitations, as well as forms of social disability and handicap [2]. Local and loco-regional changes occur as

secondary effects of the dynamic processes triggered by tooth loss. The longer the interval between the onset of edentulism and the initiation of prosthetic treatment, the more extensive and difficult to compensate the resulting structural modifications become. Reduced functionality represents the primary factor that prompts patients to recognize the need

for treatment, and constitutes the main reason for seeking dental care [3-5].

Oral rehabilitation through fixed or removable prosthetic therapy represents a major objective of modern dentistry, aiming not only at the restoration of masticatory function, but also at the aesthetic and psychosocial reintegration of the patient. Nevertheless, the long-term success of these treatments is conditioned by a multitude of variables that may act as risk factors, leading to biological or biomechanical failures. To achieve durable outcomes, close collaboration between the dentist, the dental technician, and the patient is essential in order to minimize both biological and technical risk factors.

The review aims to discuss the relationships between sociodemographic, biological and technical risk factors and the success/failure of fixed and removable prosthetic therapy in edentulous patients.

MATERIALS AND METHODS

Search Strategy

The identification of relevant studies was carried out by consulting the electronic databases PubMed/MEDLINE, PubMed Central (PMC), Scopus, and Web of Science. The literature search was performed using combinations of keywords and MeSH terms such as: "prosthetic rehabilitation", "risk factors", „biological factors”, „technical factors”, "osseointegration", "peri-implantitis", "systemic disease", "removable partial denture", "complete denture", "implant-supported overdenture", „removable hybrid prostheses”, and "fixed dental prosthesis". Search terms were used both individually and in Boolean combinations (AND/OR) to

maximize retrieval of relevant records. Priority was given to studies available in full text via PMC Open Access.

Selection Criteria

Studies were eligible if they addressed risk factors affecting clinical outcomes of fixed or removable prosthetic therapy, irrespective of the prosthetic modality: tooth-supported, implant-supported, or mucosal-bearing. Eligible study types included original manuscripts — randomized controlled trials, prospective and retrospective observational studies — documenting biological or mechanical risk factors and their association with prosthetic clinical outcomes; systematic reviews and meta-analyses assessing survival rates, complication rates, and failure patterns across prosthetic modalities; and narrative reviews from reference works in prosthodontics and related clinical disciplines. Studies were required to report outcomes quantitatively, including prosthetic survival rates, biological complication rates (abutment tooth caries, periodontal disease, endodontic complications, abutment tooth loss), mechanical complication rates (fracture, debonding, wear, retention loss), and patient-reported outcome measures over defined follow-up periods. Non-human studies, articles published before the year 2000 were excluded. Publications available exclusively in languages other than English, as well as studies limited to materials science or laboratory testing without clinical endpoint data, were also excluded.

Data Extraction and Quality Assessment

Data were extracted independently and systematically from each included article.

The following variables were recorded for each study: (a) study design and level of evidence; (b) sample size in terms of patients and prosthetic units; (c) patient-related characteristics including age, sex, systemic condition, oral hygiene status, parafunctional habits (bruxism, clenching), and smoking status; (d) type of prosthetic rehabilitation; (e) follow-up period; (f) outcome: prosthetic survival rate, biological complication rate, mechanical complication rate, abutment tooth loss, patient satisfaction scores.

LITERATURE REVIEW

1. General Context

Fixed and removable prosthetic therapy restores masticatory, phonetic, and aesthetic function, significant components of quality of life in edentulous patients. Technical precision and the appropriate choice of restoration operate within a broader clinical context influenced by local, biological, functional, and systemic factors that may interact in ways that are not always predictable when prosthetic restorations are placed. Any one of these factors, or a combination of several, can determine the difference between long-term stability and progressive failure. Recognizing and weighing them — before treatment begins and throughout its course — has become one of the core ability of modern prosthetic practice [3-5].

The prosthetic field— its periodontal status, the quality of dento-periodontal or mucosal-osseous support, the pattern of tooth loss, occlusal relationships, and the patient's capacity for adequate oral hygiene — provides the biological and structural foundation on

which any restoration must perform. Material selection, restoration design, and patient compliance add further layers of variability. Beyond the local environment, systemic conditions increasingly recognized as relevant to prosthetic outcomes — diabetes mellitus, cardiovascular disease, osteoporosis, rheumatological disorders, and other chronic pathologies — can modify tissue biology, impair healing, and raise the risk of biological complications in ways that no prosthetic design can fully compensate for if left unaddressed [3-5].

To ensure the long-term success of prosthetic treatments in extensive partial edentulism, it is essential to integrate biomechanical considerations into the treatment plan, assess dento-osseous support, meet aesthetic requirements, evaluate the resilience of the fibromucosa, consider the extent of the distal extension edentulous area, the magnitude of masticatory forces, financial constraints, as well as the presence of extensive bone loss or systemic comorbidities. Neglecting these factors may compromise both the prosthetic foundation and the success of the restoration. The degree of patient acceptance of the prosthesis is directly influenced by a multitude of biological, mechanical, aesthetic, and physiological factors [6].

2. Local risk factors in tooth- and implant-supported prosthetic therapy

Although advances in dental materials and digital technologies (CAD/CAM) have significantly improved marginal fit accuracy and the durability of prosthetic restorations, the incidence of

complications such as secondary caries, periodontal disease, and peri-implantitis remains a major challenge. Early identification of risk factors is essential for shifting from a reactive approach to a preventive and personalized strategy in prosthetic dentistry.

The assessment of both local factors (bone quality, ridge height and width, soft tissue condition) and systemic factors (diabetes, smoking, autoimmune diseases) is crucial in the planning of prosthetic restorations.

With regard to local factors, the success of fixed or removable prosthetic restorations, whether tooth-supported or implant-supported, depends largely on bone quality (trabecular density) and the volumetric characteristics of the alveolar ridge (height and width), which determine the biomechanical stability of the future prosthetic restoration [3-5].

The condition of the soft tissues and the presence of an adequate band of keratinized mucosa contribute to the establishment of a biological seal that protects the implant–bone or tooth–restoration interface against microbial challenges. Inadequate gingival architecture that is not corrected during the pre-prosthetic phase represents a major risk factor for aesthetic complications and plaque accumulation at the restoration margin [7-9].

3. Systemic risk factors in tooth- and implant-supported prosthetic therapy

Local factors must be correlated with the patient's systemic profile, which can profoundly influence healing capacity and the host immune response [10].

Pathological states, like uncontrolled diabetes mellitus lead to microvascular changes that limit the nutrition circulation in periodontal and peri-implant tissues thus increasing by several magnitudes the risk for developing infections around tooth abutments and of implant osseointegration failure [11].

Smoking, through vasoconstrictive effects and polymorphonuclear leukocyte function impairment, has been one of the most common risk factors linked to marginal bone loss (MBL) around tooth-supported and implant-supported fixed or removable prosthetic restorations.

Autoimmune diseases and immunomodulatory therapies may interfere with bone metabolism, often necessitating the postponement of definitive prosthetic treatment stages [12].

In this context, a well-founded treatment plan, meticulous clinical and laboratory procedures, and careful long-term maintenance can significantly reduce the risks associated with fixed prosthetic restorations, regardless of the type of support [13].

4. Risk factors in fixed prosthetic therapy

Fixed prosthetic restorations, whether supported by natural teeth or dental implants, are influenced by a variety of risk factors that may compromise the functional, aesthetic, and biological success of treatment [4].

In tooth-supported restorations, the principal risk factors include periodontal health status, the extent of coronal destruction, the quality of previous endodontic treatment, the insertion axis of the prosthetic abutments, and the distribution of occlusal forces. Overloading

of abutment teeth, biological width disruption, or poor oral hygiene may lead to early prosthetic failures [14].

The health of the marginal periodontium constitutes the foundation of any fixed prosthetic rehabilitation. A reduced but stable periodontium may adequately support a fixed restoration, whereas the presence of active inflammation accelerates the loss of alveolar bone support even under moderate occlusal loading. In this context, the control of the periodontal inflammation in patients with periodontal history and systemic diseases such as rheumatoid arthritis [15] or osteoporosis [16] plays an important role in the long-term success of tooth-supported fixed prosthetic therapy.

The degree of coronal destruction directly influences the biomechanics of the tooth-restoration complex. Extensive structural loss often necessitates post-and-core reconstructions, where the absence of the *ferrule effect*—defined as a 1.5–2 mm band of sound tooth structure extending coronally beyond the gingival margin—significantly increases the risk of root fracture due to unfavorable leverage forces [14]. The quality of previous endodontic treatment represents another major predictive factor. The presence of chronic periapical lesions, even when asymptomatic, may ultimately necessitate the removal of an entire fixed dental prosthesis to allow endodontic retreatment of the affected abutment tooth. From a technical perspective, the distribution of occlusal forces plays a critical role in preventing secondary occlusal trauma. Overloading of abutment teeth, often resulting from an insufficient number of supporting teeth relative to the length of the

edentulous span, accelerates periodontal ligament breakdown and increases the incidence of repeated decementation. Interference with the biological width may trigger chronic inflammatory reactions manifested by gingival hyperplasia or alveolar bone resorption. Inadequate oral hygiene combined with prosthetic designs that do not facilitate self-cleansing of interproximal areas promotes biofilm accumulation at restoration margins, leading to subgingival secondary caries, most common biological causes of long-term failure in fixed prosthodontics [14].

Risk factors in implant-supported restorations include both surgical and prosthetic factors. Diminished bone density, inaccurate placement of the implant, immediate loading and incorrect force distribution can lead to marginal bone loss or even implant failure [13]. Peri-implantitis represents another major risk factor with an increasing prevalence. It is commonly initiated by a combination of poor patient oral hygiene and inadequate prosthetic design, particularly over-contoured restorations that impede access for oral hygiene aids [13].

Mis-positioning of the implants in three-dimensional space requires angled restorative components that place unfavorable lever arms on the restorations or concentrate stress at crestal bone. Loading before completion of bone remodeling as well as insufficient force distribution in terms of parafunctional habits (e.g., bruxism) can result in early marginal bone resorption or even total implant failure through disruption of the bone–titanium interface [17].

Poor biomechanics, absence of passive fit in wide-range restorations and

inappropriate occlusal control can produce mechanical and biological problems [18]. This is not uncommonly seen in large implant-supported prostheses with a lack of passive fit, due to inadequate biomechanical planning. Any internal stresses imposed during fixation of the suprastructure are applied directly to the underlying bone and may result in microfractures within peri-implant trabecular bone. Additionally, poor occlusal guidance or lateral interferences could lead to mechanical complications directly involving the prosthetic attachments (e.g., screw loosening, screw fracture and ceramic chipping) or, in more severe instances, impacting directly on the implant body itself (e.g., fractures of the implant body) [19].

From a biological perspective, secondary dental caries was identified as the most critical risk factor, accounting for approximately 38% of all bridge failures, with a cumulative incidence of 9.5% at ten years. This was followed by loss of vitality of abutment teeth, affecting approximately 10% of cases, and periodontal disease, which, despite a lower incidence of 4%, contributed significantly to the loss of alveolar support.

From a biomechanical and technical standpoint, loss of retention (decementation) was the most frequently reported complication, with a ten-year incidence of 6.4%, followed by fracture of veneering materials (3.2%) and fracture of the abutment tooth (2.1%). The authors also emphasized the increased vulnerability of endodontically treated teeth, which demonstrated a higher risk of root fracture compared with vital teeth. Furthermore, prosthetic design directly influenced

prognosis, with cantilever bridges exhibiting significantly higher failure rates due to unfavorable distribution of occlusal forces [19]. A meta-analysis examining technical complications in implant-prosthetic therapy identified implant fractures, connection-related complications, and suprastructure-related complications as the leading causes of implant failure. The cumulative incidence of technical complications (screw loosening, fracture) was reported at 7.3%, while suprastructure-related complications, including fracture of veneering materials or framework components, accounted for as much as 14% [20].

The growing adoption of digital technologies has meaningfully changed how clinicians approach the risk factors, these advances representing a significant step toward more predictable and durable implant-supported restorations [21].

5. Risk Factors in Removable Prosthodontic Therapy

Removable partial prosthodontic rehabilitation — whether tooth-supported or implant-supported — remains one of the most widely used approaches for managing extensive partial edentulism. One of its most practical advantages is a favorable cost-effectiveness ratio, making it an accessible option for a broad range of patients and clinical settings. That said, when compared with fixed restorations supported by natural teeth or implants, removable solutions tend to offer lower clinical efficiency and require more frequent repairs over time [22, 23]. This does not, however, diminish their clinical value — well-designed removable prostheses, tailored to the patient's individual biological characteristics, can

deliver meaningful functional and aesthetic improvements even in cases where rehabilitation is particularly challenging [24]. Among the available removable options, conventional cast partial dentures stand clearly apart from their acrylic and flexible counterparts. Their reduced thickness and weight translate directly into greater patient comfort, while their chemical stability and biocompatibility make them a reliable long-term solution. Cast dentures offer considerable versatility — major connectors can be adapted to the specific extent of the edentulous area, and retention and stability are effectively achieved through the use of clasps and minor connectors [4].

In recent years, digital technologies have begun to reshape how removable partial dentures are fabricated. CAD/CAM systems are now increasingly applied to the manufacturing of suprastructures for both fixed and removable prosthetic restorations, working across a range of materials including conventional alloys, zirconia, and PMMA [25, 26]. The fit accuracy achievable through these workflows has been well documented, with [27] demonstrating the excellent adaptation of digitally fabricated restorations. Moreover, fully digital removable prosthetic solutions have shown clinical effectiveness specifically in Kennedy Class III and IV edentulous situations, further broadening the scope of their application [28, 29].

Risk factors in hybrid removable prosthodontic therapy bear directly on the durability and overall success of oral rehabilitation.

Removable partial prostheses remain a widely used treatment option — largely because of their favorable cost-

effectiveness — yet they carry well-recognized limitations: a greater need for maintenance and repairs, and lower clinical efficiency when compared with fixed restorations. In conventional cast removable partial dentures, the central risk factor is biomechanical imbalance between tooth support and mucosal support. This imbalance generates excessive torsional forces on abutment teeth through clasps and minor connectors, and can progress to iatrogenic tooth mobility and loss of epithelial attachment. On the technical side, one of the most frequently encountered complications is fracture of metallic components resulting from material fatigue [12, 30].

In implant-supported hybrid removable prostheses, risk factors are predominantly biological and technical in character [30-34]. Because implant support lacks the physiological resilience of natural teeth, it is particularly susceptible to occlusal overloading. Peri-implantitis represents another recurrent complication, most often triggered by bacterial biofilm accumulating beneath the denture base, particularly in patients with poor oral hygiene or where the acrylic base shows inadequate tissue adaptation [30-34]. Beyond these biological concerns, wear or fracture of retention systems — combined with the need for periodic relining as alveolar bone resorption progresses — constitute additional risk factors that can quietly undermine the long-term success of implant-supported hybrid therapy [33, 34].

CONCLUSIONS

Risk factors in fixed prosthetic therapy operate across multiple dimensions — patient-related, biological, mechanical,

and behavioural. Oral hygiene, periodontal status, parafunctional habits, and the condition of abutment teeth emerge as the primary modifiable determinants of prosthetic longevity, while material selection, prosthetic design, and occlusal management represent variables most directly within the clinician's sphere of influence.

Effective management of risk factors in hybrid removable prosthodontics

requires a thorough understanding of the biomechanics governing the interface between the prosthetic restoration and the biological substrate, combined with highly precise technical execution.

Treatment predictability in both fixed and removable prosthetics depends, on the pre-treatment risk assessment, the quality of the treatment plan, and the regularity of the recall protocol.

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