



Early complications of fixed dental prostheses as predictors of long-term clinical outcome

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Abstract

Introduction. In recent years, implant-supported fixed dental prostheses have evolved with CAD/CAM technology and advanced ceramic materials such as zirconia, improving efficiency and aesthetics. Despite high long-term success rates, their outcomes are still affected by biological and technical complications.

Aim. The aim of this study was to systematically review the scientific literature and to evaluate early complications of fixed dental prostheses (FDPs) and their impact on long-term clinical performance.

Materials and Methods. A systematic literature review was conducted in accordance with the PRISMA guidelines. The literature search was conducted from July 5, 2017 up to February 18, 2026, using the following electronic databases: *PubMed, ScienceDirect and the Cochrane Library*. Eight in vivo studies published in English that evaluated early biological and technical complications of fixed dental prostheses were selected for analysis. The quality of the studies was also assessed.

Results. The 8 selected in vivo studies were divided into two groups based on the aspect under investigation. The first group evaluated biological complications of restorations, with secondary caries, periodontal disease, and peri-implantitis being the most commonly identified. The second group analyzed technical complications of fixed dental prostheses, which mainly included ceramic cracks and fractures. On the other hand, some studies reported a 100% treatment success rate after 60 months.

Discussion. Biological factors were the main predictors to long-term FDP success, while technical issues were less critical and often repairable. Overall, FDPs show high survival, but outcomes depend strongly on oral hygiene and proper prosthetic planning.

Keywords. FDPs, biological complications, technical complications, dental prosthesis failure, prosthesis design complications

Ankstyvosios fiksuotų dantų protezų komplikacijos kaip ilgalaikių klinikinių rezultatų prognostiniai rodikliai

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Santrauka

Įvadas. Pastaraisiais metais implantais paremti fiksuoti dantų protezai tobulėjo kartu su CAD/CAM technologijomis ir pažangiomis keramikos medžiagomis, pavyzdžiui, cirkonio oksidu, taip pagerinant jų veiksmingumą ir estetiką. Nepaisant aukštų ilgalaikio sėkmės rodiklių, jų rezultatams vis dar daro įtaką biologinės ir techninės komplikacijos.

Tikslas. Atlikti mokslinės literatūros apžvalgą ir įvertinti ankstyvas fiksuotų dantų protezų komplikacijas ir jų poveikį ilgalaikiam klinikiniam veiksmingumui.

Metodika. Sisteminė literatūros apžvalga atlikta remiantis PRISMA gairėmis. Literatūra ieškota nuo 2017 liepos 5d., d. iki 2026 m. vasario 18d., naudojantis elektroninėmis duomenų bazėmis: *PubMed*, *ScienceDirect* ir *Cochrane library*. Analizei atrinktos 8 anglų kalba publikuotos in vivo studijos, vertinančios ankstyvasias biologines ir technines fiksuotų dantų protezų komplikacijas. Taip pat įvertinta tyrimų kokybė.

Rezultatai. Atrinkti 8 in vivo tyrimai buvo suskirstyti į dvi grupes pagal tiriamą aspektą. Pirmoje grupėje vertintos restauracijų biologinės komplikacijos iš kurių dažniausiai nustatyta antrinis kariesas, periodonto ligos ir periimplantitas. Antroje grupėje analizuotos fiksuotų dantų protezų techninės komplikacijos, kurių daugiausia apėmė keramikos skilimai ir lūžiai. Kita vertus, kai kuriuose tyrimuose buvo pranešta apie 100 % gydymo sėkmės rodiklį po 60 mėnesių.

Išvados. Biologinės komplikacijos buvo pagrindinis rizikos veiksnys ilgalaikiai FDP gydymo sėkmei, o techninės komplikacijos buvo mažiau kritiškos ir lengviau išsprendžiamos. FDP yra ilgaamžiški, tačiau rezultatai labai priklauso nuo burnos higienos ir tinkamo protezavimo planavimo.

Raktažodžiai. FDP, biologinės komplikacijos, techninės komplikacijos, dantų protezų nesėkmės, protezų konstrukcijos komplikacijos.

1. Introduction

In recent years, the range of restorative materials for implant-supported reconstructions has expanded considerably. Although metal–ceramic restorations were previously considered the gold standard, the introduction of CAD/CAM technology has enabled the use of more cost-effective materials and more efficient manufacturing processes. As a result, the use of all-ceramic materials, particularly zirconia, for implant-supported single crowns and fixed dental prostheses has increased [1 - 4]. Today, fixed dental prostheses (FDPs) play a key role in modern dentistry by restoring oral function, aesthetics, and overall oral health for a large number of patients. Given the considerable cost and time required for this type of treatment, high expectations are placed on the long-term success, durability, and clinical performance of these restorations under functional conditions [5]. The ongoing demand for improved aesthetics has driven the development and selection of advanced restorative materials for both tooth- and implant-supported prostheses [6,1]. Existing evidence suggests that FDPs may demonstrate long survival times, reaching up to 20 years in function. However, their longevity can be compromised by both biological and technical complications. In some cases, failure is associated with the loss of an abutment tooth due to irreversible biological factors. At the same time, certain technical issues, such as minor chipping or cracks, are often considered repairable and therefore not always classified as definitive failures, particularly when they can be managed clinically [3 - 9]. In contrast, biological complications, including caries and the need for endodontic treatment, are generally considered more critical, as they may significantly affect the long-term prognosis of the restoration. A comprehensive pre-treatment diagnostic assessment is essential for reducing the risk of complications in prosthetic treatment. Furthermore, the occurrence of

complications is influenced by multiple factors, such as oral health conditions, implant positioning, prosthetic design, the selection of restorative materials and pathological conditions brought about by inadequate prosthetic manufacturing or poor oral hygiene [3, 4, 7 - 10, 12, 13]. Across the included studies, outcomes were assessed using clinical and radiographic examinations, OHI-S index, and survival analyses such as Kaplan–Meier curves, in order to evaluate FDP performance, oral hygiene status, and associated complications. Therefore, the aim of this systematic review was to evaluate early technical and biological complications of fixed dental prostheses and their potential role as predictors of long-term clinical outcomes.

2. Materials and Methods

2.1. Protocol

This systematic review was conducted and reported following the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA).

2.2. Focus question

According to the PICOS framework, the study included randomized, prospective, and retrospective controlled and non-randomized clinical trials involving human patients of any age, sex, or ethnicity receiving fixed dental prostheses (P). The intervention (I) was fixed dental prosthesis treatment, while the comparison (C) involved different types of FDPs (fixed dental prostheses) and associated early complications. The outcome (O) focused on the occurrence of biological and technical complications and their potential role as predictors of long-term clinical outcomes.

The developed focus question was : what are the main early biological and technical complications associated with treatment using FDPs. .

The literature search was conducted using four electronic databases: PubMed, Cochrane Library and Sciences Direct. Medical Subject Headings

(MeSH) terms used were “FDPs” combined with “biological/ technical complications”.

Inclusion criteria:

1. Randomized, prospective, and retrospective studies published in English.
2. Access to the full text of the article;
3. Clinical studies in humans (in vivo);
4. Studies involving adult patients;
5. Studies in patients with a fixed dental prostheses;
6. Studies with at least ten patients/ten FPDs;
7. Abutment teeth were caries-free or had minor defects;
8. Studies analysing different early biological/technical complications of dental prostheses.
9. Selection of studies

Scientific literature was searched from July 5, 2017 up to February 18, 2026. . After removing duplicates, the abstracts were evaluated based on inclusion and exclusion criteria. An independent reviewer conducted the selection, with a senior reviewer making the final decision. Full-text articles were screened, and eligible studies were included. A search in PubMed, Cochrane library and Science Direct identified 16530 articles using specified keywords and filters. Literature reviews, meta-analyses, topic articles, and studies not relevant to the aim were excluded, and only articles published within the last 10 years were considered, leaving 5431 articles, which were further rejected due to inappropriate abstracts or incomplete texts. Ultimately, 8 studies were selected for final analysis. The study selection process is shown in Figure 1.

Data extraction

The study characteristics, including study design, sample size, follow-up period, and outcome measures, were independently extracted by the author.

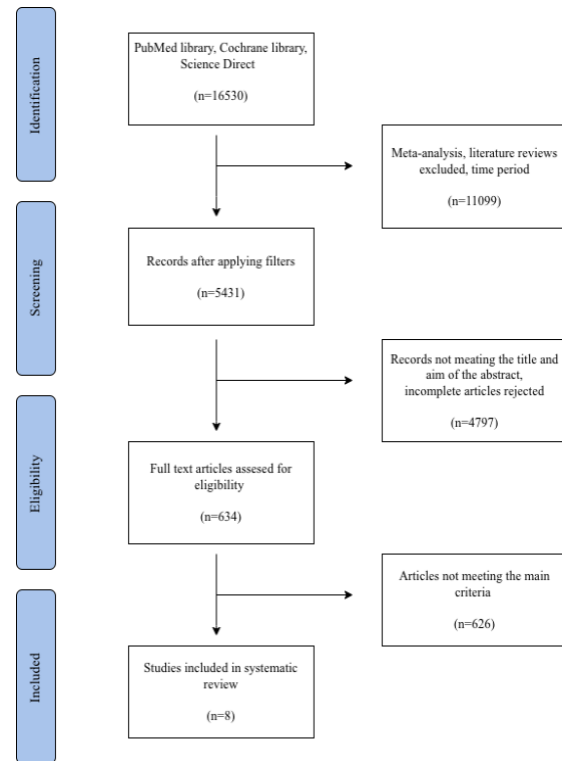


Figure 1 . Selection of studies

Assessment of methodological quality

The quality of the included study protocols was assessed following study selection by reviewing the full-text articles. The Cochrane Collaboration recommends using the Newcastle-Ottawa Scale (NOS) as a tool for assessing the quality of observational studies. This scale assigns a maximum of nine points (stars) across three domains to indicate the lowest risk of bias: (1) selection of study groups (four points), (2) comparability of groups (two points), and (3) outcome ascertainment (three points).

3. Results

3.1. Study characteristics

A total of 650 patients with different tooth- and implant-supported fixed dental prostheses were included in the analyzed in vivo studies. In total, 48,978 restorations were evaluated. The assessment was based on survival and success rates, the OHI-S index, and various statistical methods, including Kaplan–Meier analysis, Kruskal–Wallis, Mann–Whitney U, Wilcoxon signed-rank tests, linear

mixed models, and the Scheffé method, using data from interviews as well as clinical and radiographic examinations. The inclusion criteria required patients to be older than 18 years, to have at least one missing tooth requiring FDP treatment, and to meet all clinical conditions for prosthetic rehabilitation, including sufficient intra- and inter-arch space. Partially edentulous patients treated with screw-retained FDPs were also included. Patients with limited mouth opening, temporomandibular disorders, advanced periodontitis, deep caries, extensive restorations or endodontic issues, as well as those with systemic or local diseases, were excluded. In addition, all participants were non-smokers and did not present any harmful oral habits.

3.2. Fixed dental prostheses biological complications

Several studies have examined the biological complications of fixed dental prostheses (FDP's) as predictors of long-term clinical outcomes [13 - 18], affecting both tooth-supported and implant-supported restorations. Across the included studies, the most frequently reported biological complications were secondary caries, periodontal disease, and peri-implant disease. These complications were consistently observed during medium- to long-term follow-up periods and demonstrated a cumulative increase over time. In tooth-implant-supported FDPs, the overall incidence of biological complications exceeded 20 % of cases, highlighting the clinical relevance of biological factors in complex restorative designs. In a study by Simon Dahlgren and co - authors [13], among the 58 prostheses remaining in function, secondary caries were observed in almost 19 % of all prostheses, endodontic complications in four prostheses, and peri-implantitis in seven prostheses highlighting the persistence of biologically mediated failures over a mean follow-up period of 11.2 years. These findings indicate that biological factors play a

critical role in determining the longevity and clinical success of combined tooth-implant restoration. Consistent with these findings, a study by M. Sad Chaar and co - authors [14] reported that biological complications in implant-retained fixed dental prostheses (IRFDPs) were primarily associated with secondary caries, which demonstrated a measurable impact on long-term outcomes. Secondary caries affected 5 restorations which is approximately 15 % , of which two cases resulted in prosthesis loss, while the remaining cases were successfully managed without compromising restoration integrity. The 10-year cumulative secondary caries rate was 8.1 %, indicating a moderate but clinically relevant incidence over time. The study by Nadia Zafar and co - authors [15] within this cohort of tooth supported metal-ceramic fixed dental prostheses secondary caries occurred in 6.5 % of the FDPs, pulpal pathology in 7.9 %, periodontal disease was observed in 23.7 %, and the highest percentage - 41,7 % was found in decementation of FDPs presenting with complications. The authors noted that most of the decemented FPDs were fitted on abutments with inadequate resistance and retention forms. This study found that periodontal issues were primarily caused by poor oral hygiene practices. The study by Ali Alenezi and co - authors [16] found that secondary caries and the need for endodontic treatment were the primary biological complications, affecting 8.4 % and 3.7 % of FDPs, respectively, with higher rates observed in patients with poor oral hygiene (18.4 %), male patients (14.2 %), and PFM restorations (10.8 %) compared to full ceramic prostheses (3.6 %). Similar findings have been reported in the study by Arwa U. Alsaggaf other authors [18] where caries were observed that caries were observed in 7.04 %, and periodontal problems in 2.82 % of all resin bonded FDPs. Sarah Aloqayli and co - authors [17] reported that prostheses without posts had a slightly higher

biological complication rate (54.1 %) than those with posts (53.9 %) ($p=0.381$). These findings highlight that, although secondary caries does not invariably lead to restoration failure, it represents a significant biological complication with the potential to compromise long-term prosthesis survival. These results are summarized in Table 1.

3.3. Fixed dental prostheses technical complications

Among the technical complications of fixed dental prostheses, the most frequently reported in the literature are ceramic chipping or framework fractures. Studies also mentioned such technical complications as loss of retention, screw loosening or fracture, abutment or tooth fracture occlusal wear [13, 14, 16, 17 - 20]. In the study by Simon Dahlgren and co - authors [13], reported 25 % of veneer fracture while cement failure was around 15 % and fracture of screw was found in only one of all cases. Consistent with these findings, the study by M. Sad Chaar and co - authors [14], the most common complication was chipping of the veneering ceramic 20.1 %, while debonding was only one of all cases. As reported in the study by Ali Alenezi and co - authors [16], results were quite similar, it showed

that fracture (or chipping) was in 7.6 % cases, whereas debonding was detected in 0,3 % cases. The study by Irena Sailer and co - authors [19] found that chipping of veneering ceramics is a common technical complication of fixed implant prostheses, with 5-year rates ranging from 1.8 % to 11.8 % depending on the framework material. They also mentioned that loss of retention due to decementation is a common technical complication of implant crowns, occurring in 4.1 % of cemented crowns over five years. These findings are complemented by Ali Alenezi and co - authors in their study [20], where ceramic fracture or chipping was almost 25 %, while loss of retention was only about 4 % between all FDPs. The study by Sarah Aloqayli and co - authors [17] reported 8,4 % fractures and 8,4 % debonding of all FDPs. Similar findings have been reported in the study by Arwa U. Alsaggaf other authors [18] where biggest part of technical complications took debonding 37.32 %, also followed by re-cementation 21.83%, fracture of the prosthesis framework 8.45 % and chipping 7.04 % off all resin bonded FDPs. These results are summarized in Table 2.

Author, year	Study sample	Secondary caries	Endodontic treatment	Periodontitis	Periimplantitis
Simon Dahlgren et al., 2025 (13)	58 persons, 68 FDPs	19%	4		7
M. Sad Chaar et al., 2023 (14)	30 persons, 33 FDPs	15%		1	
Nadia Zafar et al., 2014 (15)	139 persons, 47474 FDPs	6,5%	11	23,7%	
Ali Alenezi et al., 2023 (16)	423 persons, 1116 FDPs	8,4%	3,7%		
Sarah Aloqayli et al., 2025 (17)	287 FDPs	54%			
U. Alsaggaf et al., 2024 (18)	34 persons, 47 FDPs	7,04%		2,82%	

Table 1. Results of biological complications.

Author, year	Study sample	Debonding/ loss of retention	Chipping / fracture	Cement failure	Loss of FDPs	Fracture of screw
Simon Dahlgren et al., 2025 (13)	58 persons, 68 FDPs		25%	10		15%
M. Sad Chaar et al., 2023 (14)	30 persons, 33 FDPs	4	20,1%		2	
Nadia Zafar et al., 2014 (15)	139 persons, 47474 FDPs			41,7%		
Ali Alenezi et al., 2023 (16)	423 persons, 1116 FDPs	0,3%	7,6%			
Sarah Aloqayli et al., 2025 (17)	287 FDPs	8,4%	8,4%			
U. Alsaggaf et al., 2024 (18)	34 persons, 47 FDPs	37,32%	8,45%			
Irena Sailer et al., 2022 (19)	Multiple studies		1,8-11,8%	4,1%		
Ali Alenezi et al., 2023 (20)	229,258	4%	25%			

Table 2. Results of technical complications.

Quality assessment

The studies included in this review were assessed using the Newcastle–Ottawa Scale and were rated as high quality, with scores ranging from 7 to 8 out of a maximum of 9 points.

4. Discussion

The findings of this review indicate that biological complications play a major role in the long-term success of fixed dental prostheses (FDPs), with secondary caries, periodontal disease, and peri-implant disease being the most frequently reported [13-17]. Secondary caries was consistently identified as the predominant complication across studies, affecting up to approximately 15 % of restorations and showing a cumulative increase over time, with a 10-year rate of 8.1 % [14]. Periodontal complications were also highly prevalent, reaching 23.7 % in tooth-supported FDPs and were mainly associated with poor oral hygiene. Peri-implant disease was similarly observed in implant-supported restorations, further emphasizing the importance of

biological factors in long-term outcomes [13]. Technical complications were also commonly reported, with ceramic chipping or framework fractures identified as the most frequent [13,14,16,17,19,20]. The incidence of veneer fractures ranged from 7.6 % to 25 % [13,16,20], while chipping rates in implant prostheses varied between 1.8 % and 11.8 % over five years [19]. Other complications, such as loss of retention, screw loosening, and abutment or tooth fractures, were less frequent, with decementation rates generally ranging from 4 % to 15 % [13,17,19,20]. In contrast, a total of 21 FDPs evaluated at 60 months showed a 100% survival rate, indicating that all restorations remained intact and functional with no loss of prostheses or failed restorations.

5. Conclusion

Biological complications, particularly secondary caries, are the most significant predictors of long-term outcomes in fixed dental prostheses, showing a cumulative increase over time and a greater impact

on prosthesis survival than technical complications. While technical issues mainly ceramic chipping or framework fractures occur frequently, they are less critical to long-term success compared to biologically driven failures.

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