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SYSTEMATIC REVIEW

Prosthesis wear and complications in various materials used for fixed implant-supported prostheses: A systematic review

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ABSTRACT

Statement of problem. Clinical evidence regarding the wear of prosthetic materials and antagonist dentition in fixed implant-supported prostheses (FIPs) remains limited, particularly for polymers such as polymethyl methacrylate (PMMA), polyoxymethylene (POM), and polyetheretherketone (PEEK).

Purpose. The purpose of this systematic review was to evaluate prosthesis wear in FIPs fabricated from different restorative materials, to identify associated patient- and treatment-related factors, and to assess their effect on antagonist teeth.

Material and methods. A systematic literature search was conducted in the PubMed, Scopus, Embase, and Web of Science databases for clinical studies with a minimum of 6 months follow-up evaluating FIPs published between January 2020 and June 2025. Extracted data included prosthesis wear, antagonist wear, prosthetic complications, and modifying clinical variables. Risk of bias was assessed using the Cochrane Risk of Bias 2.0 tool for randomized clinical trials and the Risk of Bias in Nonrandomized Studies of Interventions (ROBINS-I) tool for observational studies.

Results. Ten clinical studies fulfilled the inclusion criteria. Evaluated materials included PMMA, POM, lithium disilicate, zirconia–ceramic, and metal frameworks veneered with ceramic or acrylic resin. Quantitative wear of the prosthesis material itself was reported only for PMMA, POM, and lithium disilicate restorations, whereas in other studies, prosthesis wear was recorded exclusively as a wear-related complication. Wear-related complications, including severe material wear, chipping, screw loosening, and framework fractures, were more frequently reported in metal–acrylic resin complete arch prostheses. Bruxism and the absence of a protective occlusal devices were frequently associated with higher complication rates. Antagonist wear was quantitatively assessed in only 1 study, which reported no significant differences between prosthetic materials and natural enamel.

Conclusions. Available clinical evidence indicates that prosthesis wear is material-dependent and influenced by patient-related factors. The short-term wear behavior of PMMA and POM appears comparable, whereas clinical data on antagonist wear and long-term outcomes remain scarce. (J Prosthet Dent xxxx;xxx:xxx-xxx)

Fixed implant-supported prostheses (FIPs), both in complete arch rehabilitations and partial restorations, have become widely accepted treatment options.[1–3] As surgical techniques and digital workflows have progressed,[4] the emphasis in the current literature has shifted from implant survival, which has already been

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Clinical Implications

Clinical decision-making should incorporate patient-related factors associated with prosthetic complications, such as parafunctional habits and occlusal characteristics. Monolithic polymer restorations may be considered for short-term or controlled clinical indications.

well established,[5–7] to the performance of the prosthesis itself and the behavior of the restorative material under functional loading.[8] A broad range of materials have been used for FIPs.[9–12] Conventional options include metal–ceramic and metal–acrylic resin systems, particularly for complete arch restorations,[13,14] while metal–ceramic still remains the reference material.[15–17] The introduction of computer-aided design and computer-aided manufacturing (CAD-CAM) has allowed the clinical use of monolithic alternatives such as zirconia,[18] with reduced veneering chipping and improve efficiency.[19–22] Recently, high-density polymers such as polymethyl methacrylate (PMMA), polyoxymethylene (POM), an acetal resin, and polyetheretherketone (PEEK), an aromatic semicrystalline thermoplastic, have been proposed as definitive restorative materials for fixed implant-supported prostheses.[23–31] Increasing interest in them has been mainly related to a combination of lower elastic modulus than metals and ceramics, lower density (lightweight), and viscoelastic behavior with higher damping capacity, which may reduce stress concentration under functional loading. Additionally, these polymers generally present lower hardness and wear resistance than ceramics.[23–31] However, long-term clinical evidence for them remains limited.[32,33]

Occlusal wear is one of the most clinically relevant complications associated with FIPs, affecting both the restorative material and the antagonist dentition.[34–36] Its progression may compromise masticatory efficiency, reduce vertical dimension, destabilize occlusal equilibrium, lead to esthetic deterioration, and induce sensitivity in vital antagonist teeth.[37–40] In advanced situations, excessive wear may also contribute to temporomandibular disorders.[41–44] The magnitude of the wear depends not only on the intrinsic properties of the restorative material but also on its interaction with the opposing dentition.[39,45–47] Ideally, restorative materials should exhibit enamel-like wear resistance[48–50]; however, discrepancies in physical and mechanical properties, such as hardness, friction coefficient, elastic modulus, and surface topography, result in heterogeneous wear behavior and varying rates of antagonist wear.[39,51–53] Patient-related clinical variables can further influence wear dynamics and should therefore be considered in material selection and prosthetic planning.[54–57] Factors such as bruxism, masticatory muscle activity, occlusal scheme, saliva composition, and the use or absence of protective occlusal devices may affect the wear of both the prosthesis and the antagonist dentition.[34,58] Despite their relevance, these variables have been inconsistently reported across clinical studies.[59–61]

Although the mechanical complications of FIPs have been widely investigated,[15,62] clinical wear and its effect on antagonist dentition remain insufficiently documented.[63] Comparative clinical evidence on recently introduced CAD-CAM polymers versus conventional metal–ceramic and metal–acrylic resin systems has also been limited.[60,64] Therefore, this systematic review aimed to evaluate prosthesis and antagonist wear in FIPs, identify material-dependent differences, and analyze associated clinical factors. The null hypotheses were that no material-dependent differences would be identified in the prosthesis wear, antagonist wear, or associated prosthetic complications in fixed implant-supported prostheses and that patient-related factors would not significantly influence these outcomes.

MATERIAL AND METHODS

This systematic review was conducted following the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines and the methodological recommendations of the Cochrane Collaboration.[65] The research question was how the clinical behavior of FIPs was expressed in terms of material wear, antagonist wear, patient-related factors, and prosthetic complications, which was structured according to the Population, Intervention, Comparison, Outcomes, and Study design (PICOS) framework (Table 1).

Table 1. Study Framework Used to Define Research Question and Eligibility Criteria for Systematic Review

PICOS Element	Definition Applied in This Review
Population (P)	Patients rehabilitated with dental implants, either partial or complete arch
Intervention (I)	Fixed implant-supported prostheses
Comparison (C)	Different restorative materials used in fixed implant-supported prostheses
Outcomes (O)	Prosthesis wear and/or antagonist wear, either quantitatively measured or recorded as a wear-related prosthetic complication, clinical factors, and incidence of prosthetic complications
Study design (S)	Randomized clinical trials and observational clinical studies (prospective or retrospective).

A systematic electronic literature search was conducted in the PubMed, Scopus, Embase, and Web of Science databases covering the period from January 2020 to June 2025. Only studies published in English or Spanish were considered eligible. The search strategy was developed using combinations of predetermined keywords including the following search terms: (metal-ceramic OR monolithic zirconia OR PEEK OR Polyetheretherketone OR metal-acrylic resin OR PMMA OR POM OR porcelain OR "lithium disilicate") AND ("implant-supported" OR "fixed implant" OR "implant prosthesis" OR "fixed dental prosthesis") AND (wear OR abrasion OR "occlusal wear" OR "antagonist wear" OR complications OR survival). The same Boolean search equation was applied across all databases. In PubMed, the [TIAB] field tag was used to restrict the search to titles and abstracts, whereas the identical search equation was used in Embase, Scopus, and Web of Science without field restrictions. A manual search of reference lists was additionally performed to identify relevant studies.

Clinical studies were included when they evaluated FIPs in partial or complete arch rehabilitations and assessed wear as a primary outcome. Wear was considered eligible when quantified for the prosthesis, quantified for the antagonist dentition, or recorded as a prosthetic complication even in the absence of volumetric measurements. Studies evaluating definitive or long-term interim restoration materials encompassing zirconia, porcelain, metal–ceramic, metal–acrylic resin, lithium disilicate, PMMA or POM, PEEK, or PMMA veneered on titanium frameworks with a minimum of 6 months of clinical function were included. Other prosthetic complications not directly related to wear, such as fractures, decementation, chipping, maintenance procedures, or survival outcomes, were recorded only as secondary information. Studies were excluded if they were conducted in vitro, if they were narrative or systematic reviews, case series, or case reports, or if they evaluated tooth-supported fixed prostheses. Studies that did not evaluate wear, either quantitatively or as a recorded prosthetic complication, were also excluded.

Two independent reviewers (E.S. and S.V.R., authors) screened all titles and abstracts using predefined eligibility criteria, and duplicate records were removed at this stage. Full-text assessment was then performed for all potentially relevant studies. Any discrepancies between reviewers were resolved through discussion and consensus. Data extraction was performed using a structured spreadsheet (Excel; Microsoft Corp). For each included study, details regarding publication year, study design, sample size, type of rehabilitation, prosthetic materials, methodology, follow-up duration, methods of wear evaluation, antagonist interaction, incidence of complications, and main findings were recorded. Primary variables of interest included prosthesis wear, antagonist wear, and wear recorded as a prosthetic complication, while other prosthetic complications were considered secondary variables. A quantitative meta-analysis was not possible because of heterogeneity in study designs; therefore, a qualitative synthesis of the data was performed.

The risk of bias for randomized clinical trials (RCTs) was assessed using the Cochrane Risk of Bias 2.0 (RoB 2.0) tool.[66] Observational studies were evaluated with the Risk Of Bias In Nonrandomized Studies of Interventions (ROBINS-I) tool.[67] Traffic-light visualizations were generated using the Risk-Of-Bias visualization (robvis) tool.[68] No study was excluded based on risk of bias, as this criterion was not in the exclusion protocol.

RESULTS

The electronic database search identified 907 records. After the removal of duplicates, the titles and abstracts were screened, resulting in 19 articles selected for full-text assessment. Following full-text evaluation, 11 studies were excluded (Supplemental Table 1, available online). Ultimately, 10 studies fulfilled all eligibility criteria.[2,3,6–8,14,16,17,25,48] Of these, 9 were identified through a database search and 2[3,48] through manual screening of reference lists (Fig. 1).

Among the included studies, 3[2,25,48] were RCTs, and 7[3,6–8,14,16,17] were prospective and retrospective observational studies. The materials evaluated included monolithic zirconia, metal–ceramic, metal–acrylic resin, lithium disilicate, PMMA or POM, PEEK, and PMMA veneered on titanium frameworks. Follow-up durations varied substantially across studies, ranging from 6 months to more than 5 years. Methodological characteristics of the included studies are summarized in Table 2. Three RCTs[2,25,48] were judged to present some concerns regarding overall risk of bias (Fig. 2A). Among the observational studies (Figs. 2B, 3) were classified as having a high risk of bias,[3,6,16] whereas others demonstrated a moderate risk of bias.[7,8,14,17]

Prosthesis wear was quantitatively assessed in 3 studies (Table 3),[2,25,48] while the remaining studies reported wear only as a clinical complication.[3,6–8,14,16,17] Two RCTs evaluated partial PMMA and POM FIPs over 6 months and found significant wear progression without differences among materials.[2,25] The wear was assessed using the standardized photographic comparison of silicone-derived casts and CAD-based analysis,[35,36] with alteration[25] or increased radius[2] of the cusp curve interpreted as wear. One trial[48] evaluated lithium disilicate partial FIPs (≤3 units) up to 24 months using intraoral scanning, STL generation, and 3-dimensional superimposition, reporting maximum wear of

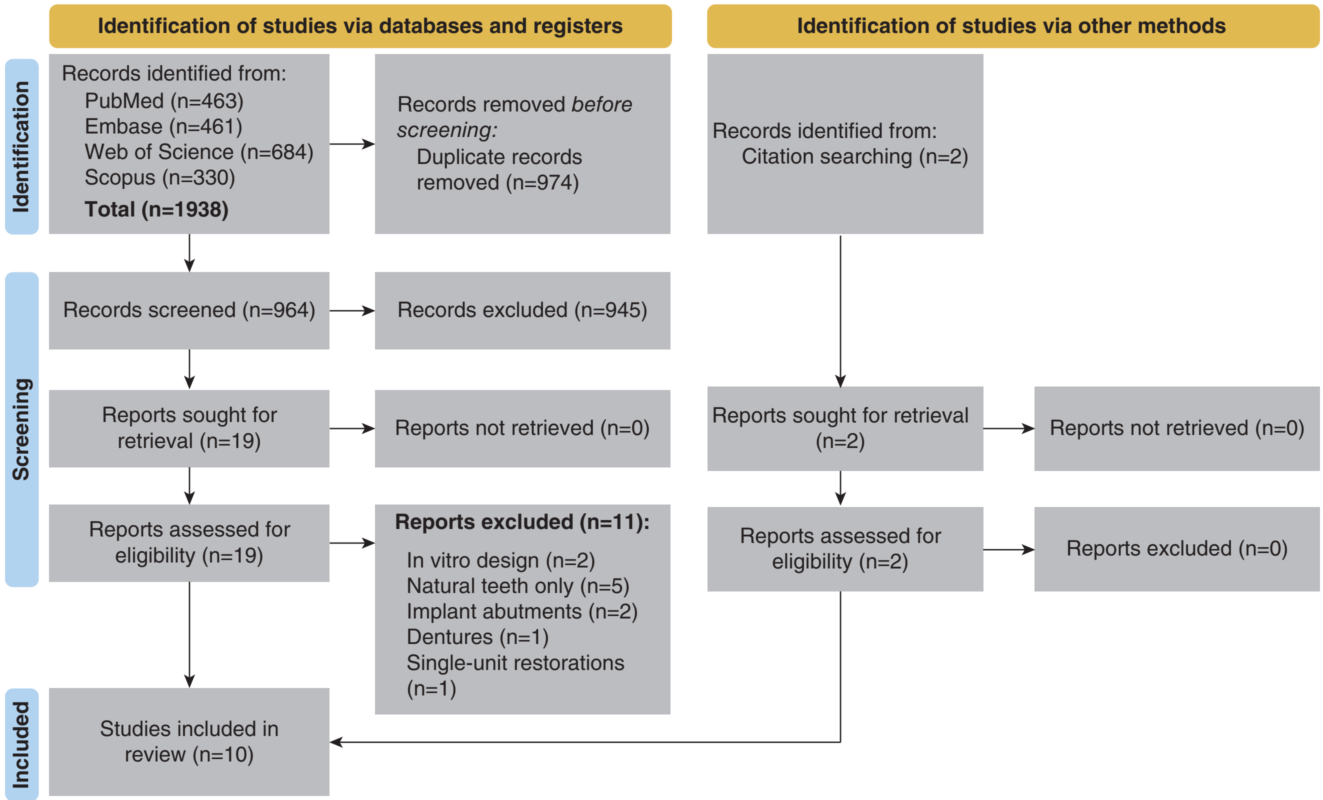

Figure 1. PRISMA 2020 flow diagram for systematic reviews, including searches of databases, registers, and other sources.

50 ±51 μm at 12 months and 61 ±56 μm at 24 months. Antagonist wear was quantitatively assessed in only 1 lithium disilicate study using STL superimposition at baseline, 12, and 24 months, reporting enamel mean ±standard deviation wear of 69 ±28 μm and 81 ±35 μm at 12 and 24 months, respectively, with no significant differences versus lithium disilicate (P>.05).[48]

Patient- and prosthesis-related modifiers were inconsistently reported and included bruxism, occlusal device use, occlusal pattern, cantilevers, implant number, implant connection type, abutment angulation, and antagonist type. Several studies excluded patients with bruxism or temporomandibular disorders to reduce confounding,[2,25,48] and 1 prospective study provided occlusal devices to all patients.[16] Bruxism and lack of an occlusal device were associated with higher failures and complications in complete arch cohorts.[6,7] In 1 titanium–acrylic resin cohort, wear and chipping were more frequent in men with bruxism, and chipping occurred more often with canine guidance than with mutually protected occlusion.[16] Occlusal type was not associated with acrylic resin tooth replacement in another metal–acrylic resin cohort.[3]

Beyond wear, studies frequently reported technical complications and survival outcomes, including chipping, loss of access-channel filling material, screw loosening, abutment loosening, retention loss, and framework fracture (Fig. 3).[3,6–8,14,16] In most reports, wear was classified qualitatively as mild or severe and grouped within minor or major complications, mainly in complete arch metal–acrylic resin prostheses,[3,6,7,16,17] with additional complete arch cohorts in metal–ceramic[6,7] and zirconia–porcelain,[8] and a partial-prosthesis cohort in porcelain-veneered cobalt–chromium and titanium frameworks.[14] Only 1 study identified wear as a frequent complication without reporting a percentage,[3] whereas 3 studies quantified wear-related complication rates in complete arch cohorts.[6,7,16] In a metal–ceramic and metal–acrylic resin cohort, minor complications affected 81.25% of prostheses and major complications affected 18.75%, with severe wear the most frequent major event.[7] Another cohort reported 89% survival over 1 to 10 years and significantly more minor and major complications in metal–acrylic resin than in metal–ceramic prostheses.[6] A prospective titanium–acrylic resin cohort reported 100% survival at 12 months, with minor complications in 17.9% and major complications in 42.9%, including 1 severe wear event and multiple chipping episodes requiring laboratory repair.[16] In another metal–acrylic resin cohort, survival was also 100% at 1 year or longer, with screw loosening and abutment loosening as the most frequent complications and higher loosening risk with fewer implants and 30-degree angled abutments.[3] In partial PMMA and

Table 2. Methodological Characteristics of Studies Included in Systematic Review

Study	Study Design	Prosthesis Type and Material	Main Study Objectives	Follow-up	Wear/Outcome Assessment	Relevant Methodological Notes
Díez-Quijano et al, 2020[25]	Randomized clinical trial	Partial implant-supported prostheses (2–4 units); PMMA (n=25) vs POM (n=24)	Compare materials regarding CDA parameters, color change, and occlusal wear	6 months	Clinical evaluations (2, 4, 6 months); spectrophotometry (baseline, 6 months); photographic wear analysis	Bruxism excluded; patients with removable prostheses in antagonist arch excluded
Mackert et al, 2024[17]	Retrospective observational	Complete arch fixed implant-supported metal–acrylic resin prostheses (n=84)	Evaluate prosthetic survival, complication rates, and antagonist arch at failure	Up to 15 years	Retrospective clinical data review	Prosthetic failure defined only when replacement was required, not when complications occurred
Mandal et al, 2022[6]	Retrospective observational	Complete arch fixed implant-supported prostheses: metal–acrylic resin (n=79) and metal–ceramic (n=21)	Analyze complications and survival; assess influence of parafunction, occlusal device use, and patient satisfaction	1 to 10 years	Retrospective clinical data review	Bruxism and occlusal device use evaluated as modifying factors
Nikellis et al, 2022[16]	Prospective observational	Complete arch fixed implant-supported titanium framework with acrylic resin veneering	Assess incidence of complications and patient-reported outcomes (OHIP-14); secondary analysis of survival and risk factors	12 months	Clinical evaluations at 3, 6, and 12 months; OHIP-14 questionnaire	Survival defined as absence of prosthesis removal; all patients received occlusal devices
Nilsson et al, 2022[14]	Retrospective observational	Partial and complete implant-supported prostheses in CoCr–porcelain and Ti–porcelain	Evaluate clinical outcomes, success, survival, and complications	Mean 7.5 years	Clinical examinations and patient interviews; CDA criteria	Success, survival, and failure defined using CDA categories
Sravanthi et al, 2024[2]	Randomized clinical trial	Partial implant-supported prostheses (2–4 units); PMMA (n=25) vs POM (n=24)	Evaluate clinical behavior, color stability, and occlusal wear	6 months	CDA parameters; spectrophotometry; photographic wear analysis	Bruxism, clenching, and non–mutually protected occlusion excluded
Chochlidakis et al, 2020[7]	Retrospective observational	Complete arch fixed implant-supported prostheses: metal–ceramic (n=10) and metal–acrylic resin (n=38)	Compare prosthetic complications, visual wear assessment, and survival	Mean 3.5 years	Clinical examinations, radiographs, photographs; satisfaction questionnaire	Occlusal device use and bruxism evaluated
StÜck et al, 2022[48]	Randomized clinical trial	Partial implant-supported prostheses (≤3 units) in lithium disilicate (n=56)	Quantify wear of prostheses, antagonists, and lateral contacts	24 months	Digital STL superimposition from intraoral scans	Dental migration assessed to exclude confounding; TMD patients excluded
Younes et al, 2024[3]	Retrospective observational	Complete arch fixed implant-supported metal–acrylic resin prostheses (n=64)	Analyze complications, survival, cantilever length, and implant number	1 to 12 years	Clinical and radiographic evaluation	Criteria for success or survival not explicitly defined
Thompson et al, 2025[8]	Retrospective observational	Complete arch fixed implant-supported zirconia–porcelain prostheses (n=67 arches)	Evaluate prosthetic survival and causes of failure; assess influence of antagonist type	Median 8.5 months (2.7 to 30.9)	Review of clinical records and radiographs	Wear included among recorded failure causes

CDA, California Dental Association; CoCr, cobalt chromium alloy; OHIP-14, Oral Health Impact Profile–14 questionnaire PMMA, polymethyl methacrylate; POM, polyoxymethylene; STL, standard tessellation language; Ti, titanium; TMD, temporomandibular disorder.

Risk of bias domains

Study	D1	D2	D3	D4	D5	Overall
Sravanthi et al	−	+	+	−	+	−
Díez-Quijano et al	−	+	+	+	+	−
Stück et al	+	+	−	+	+	−

Domains:
D1: Bias arising from the randomization process.
D2: Bias due to deviations from intended intervention.
D3: Bias due to missing outcome data.
D4: Bias in measurement of the outcome.
D5: Bias in selection of the reported result.

Judgement
− Some concerns
+ Low

A

Risk of bias domains

Study	D1	D2	D3	D4	D5	D6	D7	Overall
Mackert et al	−	+	−	+	−	+	+	−
Younes et al	×	+	+	+	+	−	+	×
Nikellis et al	×	+	+	+	−	+	+	×
Mandal et al	×	−	−	+	+	−	+	×
Thompson et al	−	+	+	+	−	−	+	−
Chochlidakis et al	−	−	+	+	+	+	+	−
Nilsson et al	−	−	+	+	+	+	+	−

Domains:
D1: Bias due to confounding.
D2: Bias due to selection of participants.
D3: Bias in classification of interventions.
D4: Bias due to deviations from intended interventions.
D5: Bias due to missing data.
D6: Bias in measurement of outcomes.
D7: Bias in selection of the reported result.

Judgement
× Serious
− Moderate
+ Low

B

Figure 2. Traffic-light visualization of risk of bias assessment. A, Risk of Bias 2.0 domains for randomized clinical trials. B, ROBINS-I domains for observational studies.

POM trials, implant connection type influenced complications, and fractures requiring replacement occurred in 28% of PMMA and 12% of POM prostheses without significant differences among materials.[2,25] In contrast, a zirconia–porcelain complete arch cohort reported 9 failures, including framework and veneering fractures, with Kaplan–Meier survival of 88.8% at 1 year and 72.5% at 5 years.[8] Long-term data from a metal–acrylic resin cohort showed that, at 15 years, excessive wear accounted for 19% of failures and that failure risk was higher with natural dentition, removable partial dentures, or complete arch fixed prostheses as antagonists.[17] In a porcelain-veneered titanium and cobalt chromium framework cohort with a mean 7.5-year follow-up, occlusal wear, cantilevers, and longer functional time negatively affected success and survival.[14] The main clinical outcomes of the studies are summarized in Table 4. Overall, at 2.5 to 4.5 years of follow-up, metal–acrylic resin prostheses demonstrated the highest survival rates,[3,6] whereas cobalt chromium–ceramic prostheses showed lower survival. At 5 to 8 years, zirconia–ceramic exhibited the highest survival,[8] followed by titanium–ceramic and cobalt chromium–ceramic prostheses, while metal–acrylic resin prostheses showed the lowest survival (Fig. 4).[17]

DISCUSSION

The findings of this systematic review partially rejected the null hypotheses that no material-dependent differences would be identified in the prosthesis wear,

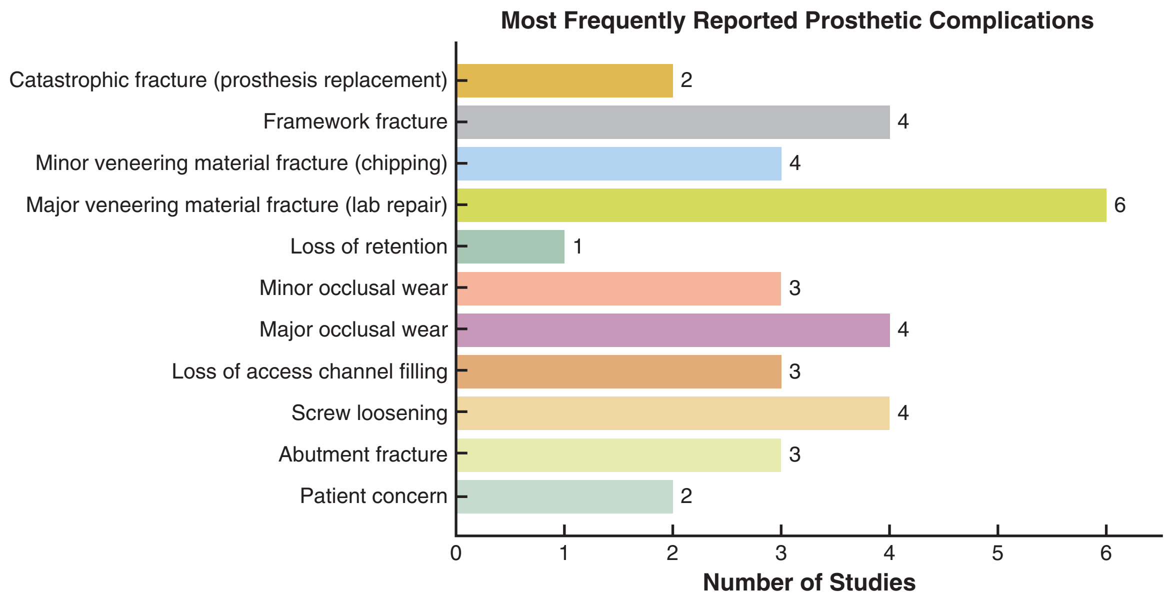

Figure 3. Distribution of most frequently reported prosthetic complications in the included clinical studies. Bars represent the number of studies reporting each complication.

antagonist wear, or associated prosthetic complications of fixed implant-supported prostheses and that patient-related factors would not significantly influence these outcomes. Although quantitative data remain limited, material-dependent trends in prosthesis wear and wear-related complications were observed across the included studies.

This review synthesized clinical evidence in FIPs, including prosthesis and antagonist wear, modifying clinical factors, and complications. Wear behavior appeared material- and design-dependent. Quantitative data were available only for partial restorations (lithium disilicate, PMMA, and POM): lithium disilicate showed enamel-comparable wear,[40,45,48] while PMMA and POM exhibited measurable 6-month wear without differences among materials,[2,25] suggesting that material composition may not be the only determinant of early wear in polymers. Qualitative reporting indicated greater clinical wear in metal–acrylic resin than in ceramic-veneered restorations, consistent with their lower hardness and greater susceptibility to surface degradation.[6,7,17]

Antagonist wear remains markedly under-investigated in clinical studies. Only 1 included study quantitatively evaluated antagonist wear and reported no significant differences between enamel opposing lithium disilicate restorations and enamel opposing natural teeth.[48] These findings aligned with those of previous clinical studies on monolithic ceramics, which have shown antagonist wear values comparable with those of natural enamel–enamel contacts.[40,45] However, conflicting evidence exists, as other investigations have reported increased antagonist wear when opposing zirconia restorations.[49] Patient-related factors, particularly bruxism, occlusal scheme, and the use of protective occlusal devices, appear to play a critical role in the clinical behavior of implant-supported prostheses. Several studies excluded patients with parafunctional habits to reduce confounding,[2,25,48] whereas others identified bruxism and absence of occlusal device use as significant risk factors for prosthetic complications and failure.[6,7] Although a direct association between bruxism and quantitative wear values has not been conclusively

Table 3. Quantitative Wear Outcomes of Prosthetic Materials in Included Clinical Studies

Prosthetic Material	Study	Follow-up	Wear Assessment Method	Quantitative Wear Outcome
PMMA	Sravanthi et al, 2024	6 months	Photographic analysis of cusp curvature	Not reported quantitatively
	Díez-Quijano et al, 2020	6 months	Change in cusp curvature radius (photographic analysis)	Increase in radius from baseline to 6 months: 0.558 ±0.740 mm
POM	Sravanthi et al, 2024	6 months	Change in cusp curvature radius (photographic analysis)	Increase in radius from baseline to 6 months: 0.994 ±2.062 mm
	Díez-Quijano et al, 2020	6 months	Change in cusp curvature radius (photographic analysis)	Increase in radius from baseline to 6 months: 0.990 ±2.060 mm
Lithium disilicate	StÜck et al, 2022	24 months	Digital STL superimposition (intraoral scans)	Maximum cusp height loss: 61 ±56 μm

PMMA, polymethyl methacrylate; POM, polyoxymethylene; STL, standard tessellation language.

Table 4. Main Outcomes of Studies Included in Systematic Review

Study	Study Design	Study Participants	Wear Outcomes	Prosthetic Complications	Other Relevant Outcomes
Díez-Quijano et al, 2020[25]	Randomized clinical trial	20 patients; 25 PMMA and 24 POM partial implant-supported prostheses (28 two-unit, 17 three-unit, 4 four-unit)	Significant wear differences between baseline and 6 months ($P<.05$); no significant differences between PMMA and POM	No significant differences in fracture rates between materials (28% PMMA, 12.5% POM); significantly higher fracture incidence in implants with internal conical connections, independent of material; significant changes in marginal adaptation and form between baseline and 6 months, without among material differences	Significantly better color stability in PMMA than POM
Mackert et al, 2024[17]	Retrospective observational	84 complete arch implant-supported metal–acrylic resin prostheses in 55 patients	N/A	Failure of 31 prostheses: 61% due to non-repairable acrylic resin fracture, 19% due to excessive wear, 13% due to patient concerns, and 7% due to implant loss	Failure risk significantly higher when antagonists were natural dentition, removable partial dentures, or complete arch fixed implant-supported prostheses
Mandal et al, 2022[6]	Retrospective observational	100 patients with complete arch implant-supported prostheses (79 metal–acrylic resin, 21 metal–ceramic)	N/A	Prosthetic survival: 89%; significantly higher major complication rates in metal–acrylic resin prostheses, including material chipping, loss of access channel filling, and framework fractures	Prosthetic failures significantly associated with bruxism and absence of occlusal device; higher complication rates when antagonist dentition natural teeth
Nikellis et al, 2022[16]	Prospective observational	28 patients with complete arch implant-supported metal–acrylic resin prostheses	N/A	Survival 100% at 12 months; 17.86% minor complications and 42.86% major complications, including 1 case of severe wear and 27 chipping episodes in 10 patients requiring laboratory repair	Wear and chipping significantly associated with bruxism and gender; chipping also associated with occlusal pattern; OHIP-14 scores remained low with no significant changes over time
Nilsson et al, 2022[14]	Retrospective observational	63 patients; 53 implant-supported prostheses in Ti–porcelain (n=37) or CoCr–porcelain (n=16)	N/A	Success rates: 63.5% (CoCr) and 43.2% (Ti); survival rates: 62.5% (CoCr) and 70.3% (Ti); 8 prostheses required laboratory repair; no framework fractures	Occlusal wear, cantilever presence, and longer functional time negatively influenced success; cantilever presence and functional time negatively influenced survival
Sravanthi et al, 2024[2]	Randomized clinical trial	21 patients; 25 PMMA and 24 POM partial implant-supported prostheses	Significant wear between baseline and 6 months; no significant differences among materials, although numerically higher wear in POM	Fractures requiring replacement occurred in 28% of PMMA and 12% of POM prostheses, without significant differences	Significantly higher fracture incidence in internal conical connections; significantly poorer color stability in POM
Chochlidakis et al, 2020[7]	Retrospective observational	48 complete arch implant-supported prostheses (10 metal–ceramic, 38 metal–acrylic resin)	N/A	Minor complications in 81.25% of prostheses (metal–ceramic: minimal wear; metal–acrylic resin: loss of access channel filling); major complications in 18.75%, with severe wear being the most frequent major complication	No significant differences in patient satisfaction; higher risk of minor chipping and framework fractures in patients without occlusal devices; minor chipping associated with bruxism
StÜck et al, 2022[48]	Randomized clinical trial	11 lithium disilicate implant-supported crowns at 12 months (1 patient lost at 24 months)	Maximum vertical wear in lithium disilicate crowns: 50 ±51 µm at 12 months and 61 ±56 µm at 24 months	N/A	Maximum vertical antagonist enamel wear: 69 ±28 µm at 12 months and 81 ±35 µm at 24 months
Younes et al, 2024[3]	Retrospective observational	64 patients with complete arch implant-supported metal–acrylic resin prostheses	N/A	Most frequent complications: occlusal wear (not quantified), prosthetic screw loosening (16.6%), and abutment loosening (8.1%)	Prosthetic survival 100%; 82.8% of patients lacked mutually protected occlusion, without significant association with tooth replacement; screw loosening increased with fewer implants ($P<.05$); abutment loosening more frequent in 30-degree angled and distal abutments ($P<.05$)
Thompson et al, 2025[8]	Retrospective observational	67 complete arch zirconia–porcelain implant-supported fixed prostheses (46 maxillary, 21 mandibular)	N/A	Nine prosthetic failures requiring replacement: framework fracture (n=3), implant loss (n=2), patient-related concerns (n=2), veneering porcelain fracture (n=1), and unknown cause (n=1)	Kaplan–Meier survival rates of 88.8% at 1 year and 72.5% at 5 years; framework fracture most frequent failure mode; failure risk influenced by opposing dentition, with lower survival when opposing fixed implant-supported prostheses or natural dentition present

CDA, California Dental Association; CoCr, cobalt chromium alloy; PMMA, polymethyl methacrylate; POM, polyoxymethylene; OHIP-14, Oral Health Impact Profile–14; Ti, titanium; µm, micrometer; N/A, not applicable.

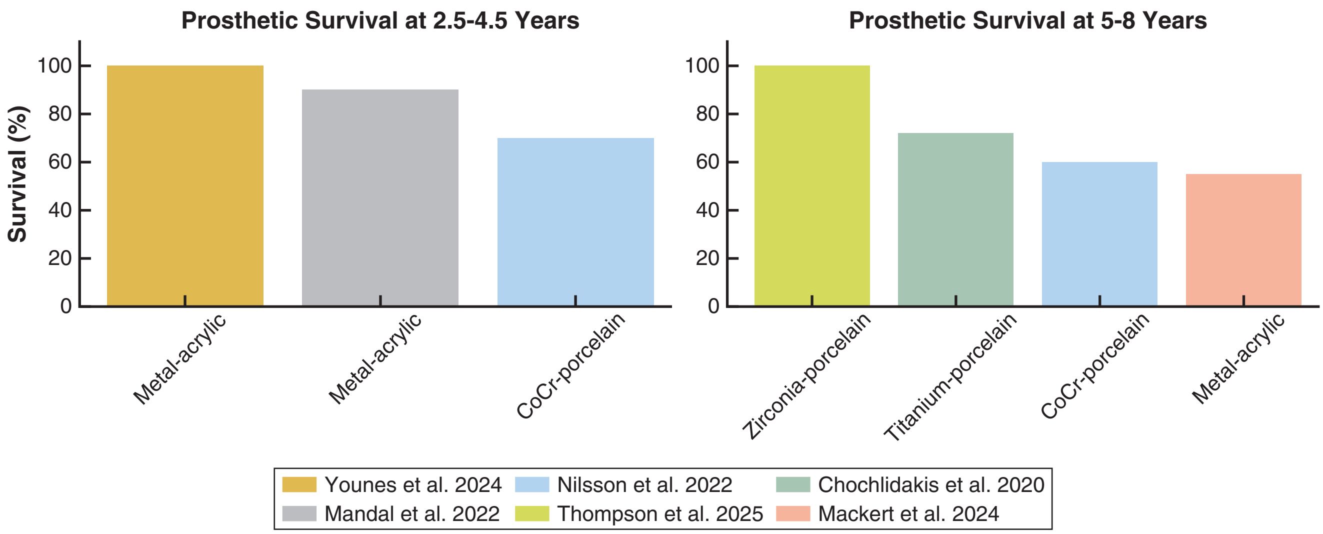

Figure 4. Results of included studies evaluating prosthetic survival at follow-up intervals of 2.5 to 4.5 years and 5 to 8 years, corresponding to the time periods most frequently reported in literature.

demonstrated,[43] its influence on complication rates supports previous evidence linking parafunction to mechanical overload in implant-supported rehabilitations.[44,55] Additional modifiers, such as antagonist dentition, cantilever presence, and implant number, further influenced outcomes, underscoring that wear should be interpreted in a multifactorial context.[14,17]

Wear-related complications were reported heterogeneously and were often embedded within broader categories of technical complications. Metal–acrylic resin restorations demonstrated higher rates of wear-related and structural complications compared with ceramic-veneered restorations, particularly in long-term follow-up.[6,17] In several studies, wear was identified as a contributing factor to prosthesis failure rather than an isolated outcome, accounting for a significant proportion of prosthesis replacements over time.[17] Conversely, ceramic-based restorations, including zirconia–porcelain systems, showed lower wear-related failure rates but were more prone to catastrophic framework or veneering fractures.[8] These findings suggest that the clinical impact of wear must be interpreted alongside other mechanical complications when selecting materials for implant-supported prostheses. Clinically, progressive occlusal wear may alter occlusal contacts and increase mechanical demands on prosthesis components, potentially leading to technical complications such as screw loosening, chipping, and framework fracture.

From a clinical perspective, no restorative material can be considered wear-free under functional conditions. Given the limited number of available clinical investigations, in vitro wear studies provide a complementary framework for interpreting material performance, particularly for recently introduced polymer-based materials. Experimental data suggest that polymer-based materials such as PMMA, POM, and PEEK exhibit higher material wear but reduced antagonist enamel wear compared with ceramics, consistent with their lower hardness and elastic modulus,[39,51,53] whereas lithium disilicate and zirconia generally demonstrate lower material wear, with antagonist wear strongly influenced by surface finishing and microstructural characteristics.[40,45,49,51] The clinical findings identified in this review appear broadly consistent with these laboratory observations, particularly regarding early polymer wear and the enamel-compatible wear behavior of lithium disilicate.[48] Consequently, material selection should consider functional demands, antagonist dentition, occlusal design, parafunction, and occlusal device use, particularly in complete arch rehabilitations.

Limitations of this review include the small number of eligible clinical studies that directly quantify occlusal wear, which weakens the evidence and limits confidence in material-to-material comparisons. The lack of quantitative wear data for complete arch implant-supported prostheses, along with the marked heterogeneity in wear assessment methodologies, further restricts direct comparisons and precludes meta-analysis. Variations in follow-up duration, outcome definitions, and control of confounding clinical variables add additional uncertainty. Moreover, the lack of in vivo studies evaluating monolithic zirconia wear in implant-supported prostheses represents a significant gap in the current literature. Future research should prioritize standardized digital wear assessment protocols, longer follow-up periods, and simultaneous evaluation of the prosthesis and antagonist wear to strengthen the clinical evidence base.

CONCLUSIONS

Based on the findings of this systematic review, the following conclusions were drawn:

1. Lithium disilicate demonstrated occlusal wear comparable with that of zirconia and enamel–-enamel contacts, while metal–acrylic resin prostheses tended to exhibit greater wear than metal–ceramic restorations under clinical conditions.
2. Evidence indicates that lithium disilicate does not induce greater antagonist enamel wear than natural tooth contacts, although data for other materials remain limited.
3. The influence of patient-related factors such as bruxism, occlusal pattern, and occlusal device use on quantitative wear could not be conclusively determined, but these factors were consistently associated with increased prosthetic complications.
4. Wear-related complications were more frequently reported in metal–acrylic resin complete arch restorations and may contribute to long-term prosthesis failure.

APPENDIX A. SUPPORTING INFORMATION

Supplemental data associated with this article can be found in the online version at doi:10.1016/j.prosdent.2026.03.044.

REFERENCES

1. Froimovici FO, Butnăraşu CC, Montanari M, Săndulescu M. Fixed full-arch implant-supported restorations: Techniques review and proposal for improvement. *Dent J*. 2024;12:408.
2. Sravanthi D, Duseja S, Mansoor MA, et al. Clinical evaluation of two distinct materials for implant-supported interim fixed partial prostheses: An original research. *J Pharm Bioallied Sci*. 2024;16:S651–S654.
3. Younes IA, Able FB, De Moraes KC, Sartori IAM. Survival rate of implants and mechanical complications for 64 implant-supported complete arch prostheses in maxillary edentulous patients with a follow-up of up to 12 years: A cross-sectional analytical study. *Int J Oral Maxillofac Implants*. 2024;39:823–828.
4. Bessa L, Fonseca J, Cardoso JA, et al. B-Guide system: Improving the predictability of complete arch implant and prosthetic placement using fixed prosthesis guides. *J Esthet Restor Dent*. 2025;37:208–220.
5. Kupka JR, KÖnig J, Al-Nawas B, et al. How far can we go? A 20-year meta-analysis of dental implant survival rates. *Clin Oral Investig*. 2024;28:541.
6. Mandal NB, Kumari A, Yemineni BC, et al. The prosthetic complications and the survival of the implant-fixed complete dental prostheses: An original study. *J Pharm Bioallied Sci*. 2022;14:S301–S303.
7. Chochlidakis K, Einarsdottir E, Tsigarida A, et al. Survival rates and prosthetic complications of implant fixed complete dental prostheses: An up to 5-year retrospective study. *J Prosthet Dent*. 2020;124:539–546.
8. Thompson J, Schoenbaum TR, Pannu D, Knoernschild K. Survival analysis of zirconia implant-supported, fixed complete dentures: A 5-year retrospective cohort study. *J Prosthet Dent*. 2025;133:790–795.
9. Ionescu RN, Totan AR, Imre MM, et al. Prosthetic materials used for implant-supported restorations and their biochemical oral interactions: A narrative review. *Materials (Basel)*. 2022;15:1016.
10. Strasding M, Marchand L, Merino E, et al. Material and abutment selection for CAD/CAM implant-supported fixed dental prostheses in partially edentulous patients - A narrative review. *Clin Oral Implants Res*. 2024;35:984–999.
11. ÇÖmlekoğlu ME, Tekeroğlu F, DÜndar ÇÖmlekoğlu M, et al. Clinical wear and quality assessment of monolithic and lithium disilicate layered zirconia restorations. *Aust Dent J*. 2021;66:413–422.
12. Selvaraj U, Koli DK, Jain V, Nanda A. Evaluation of the wear of glazed and polished zirconia crowns and the opposing natural teeth: A clinical pilot study. *J Prosthet Dent*. 2021;126:52–57.
13. Bozini T, Petridis H, Garefis K, Garefis P. A meta-analysis of prosthodontic complication rates of implant-supported fixed dental prostheses in edentulous patients after an observation period of at least 5 years. *Int J Oral Maxillofac Implants*. 2011;26:304–318.
14. Nilsson S, Stenport VF, Nilsson M, GÖthberg C. A retrospective clinical study of fixed tooth- and implant-supported prostheses in titanium and cobalt-chromium-ceramic: 5-9-year follow-up. *Clin Oral Investig*. 2022;26:6097–6103.
15. Gonzalez-Gonzalez I, deLlanos-Lanchares H, Brizuela-Velasco A, et al. Complications of fixed full-arch implant-supported metal-ceramic prostheses. *Int J Environ Res Public Health*. 2020;17:4250.
16. Nikellis T, Lampraki E, Romeo D, et al. Survival rates, patient satisfaction, and prosthetic complications of implant fixed complete dental prostheses: a 12-month prospective study. *J Prosthodont*. 2023;32:214–220.
17. Mackert J, El-Shewy M, Pannu D, Schoenbaum T. Prosthetic complications and survival rates of metal-acrylic implant fixed complete dental prostheses: A retrospective study up to 10 years. *J Prosthet Dent*. 2024;132:766–771.
18. Rabel K, Spies BC, Pieralli S, et al. The clinical performance of all-ceramic implant-supported single crowns: A systematic review and meta-analysis. *Clin Oral Implants Res*. 2018;29:196–223.
19. de Lima E, Tanaka CB, Meira JBC, et al. Effect of processing methods on the chipping resistance of veneered zirconia. *J Mech Behav Biomed Mater*. 2022;126:104995.
20. Zarone F, Di Mauro MI, Ausiello P, et al. Current status on lithium disilicate and zirconia: A narrative review. *BMC Oral Health*. 2019;19:134.
21. Tajti P, Solyom E, Czumbel LM, et al. Monolithic zirconia as a valid alternative to metal-ceramic for implant-supported single crowns in the posterior region: A systematic review and meta-analysis of randomized controlled trials. *J Prosthet Dent*. 2024;132:881–889.
22. Sailer I, Strasding M, Valente NA, et al. A systematic review of the survival and complication rates of zirconia-ceramic and metal-ceramic multiple-unit fixed dental prostheses. *Clin Oral Implants Res*. 2018;29:184–198.
23. Papathanasiou I, Kamposiora P, Papavasiliou G, Ferrari M. The use of PEEK in digital prosthodontics: A narrative review. *BMC Oral Health*. 2020;20:217.
24. Huettig F, Prutscher A, Goldammer C, et al. First clinical experiences with CAD/CAM-fabricated PMMA-based fixed dental prostheses as long-term temporaries. *Clin Oral Investig*. 2016;20:161–168.
25. DÍez-Quijano C, Azevedo L, Antonaya-MartÍn JL, et al. Evaluation of the clinical behavior of 2 different materials for implant-supported interim fixed partial prostheses: A randomized clinical trial. *J Prosthet Dent*. 2020;124:351–356.
26. Mishra SK, Bhasmey SR, Chowdhary R. Complete arch implant-supported fixed dental prostheses fabricated with PEEK and PEKK framework: A systematic review. *Evid Based Dent*. 2023;24:193.
27. Villefort RF, Diamantino PJS, Zeidler S, et al. Mechanical response of PEKK and PEEK as frameworks for implant-supported full-arch fixed dental prosthesis: 3D finite element analysis. *Eur J Dent*. 2022;16:115–121.
28. Abou-Ayash S, Schimmel M, Özcan M, et al. Trueness and marginal fit of implant-supported complete arch fixed prosthesis frameworks made of high-performance polymers and titanium: An explorative in-vitro study. *J Dent*. 2021;113:103784.
29. Yilmaz B, Donmez MB, GÜven ME, et al. Trueness and fit of complete arch implant-supported frameworks in new-generation additively and subtractively manufactured polymers: An in-vitro study. *Clin Implant Dent Relat Res*. 2024;26:986–997.
30. Oudkerk J, Herman R, Eldafrawy M, et al. Intraoral wear of PICN CAD-CAM composite restorations used in severe tooth wear treatment: 5-year results of a prospective clinical study using 3D profilometry. *Dent Mater*. 2024;40:1056–1063.
31. Ayyadanveettil P, Thavakkara V, Latha N, et al. Randomized clinical trial of zirconia and polyetheretherketone implant abutments for single-tooth implant restorations: A 5-year evaluation. *J Prosthet Dent*. 2022;128:1275–1281.
32. Wang J, Gu JT, Meng M, et al. Polyetheretherketone framework for implant-supported full-arch fixed dental prostheses in a periodontitis patient with a 6-year follow-up: A case report. *Chin J Dent Res*. 2022;25:149–158.
33. Ali SA, Abozaed HW, Jazar HA, Mostafa AZH. Surface hardness and wear resistance of prefabricated and CAD-CAM milled artificial teeth: A cross-over clinical study. *J Prosthodont*. 2025;34:15–25.
34. Yoon D, Pannu D, Hunt M, Londono J. Occlusal considerations for full-arch implant-supported prostheses: A guideline. *Dentistry Rev*. 2022;2:100042.
35. David S, Del Rio J, CelemÍn A, Serrano C. vivo study of the wear of a reinforced composite used to cover implant-supported frameworks. *Int J Prosthodont*. 2009;22:358–360.
36. Heintze SD. How to qualify and validate wear simulation devices and methods. *Dent Mater*. 2006;22:712–734.

37. Dahl BL, Carlsson GE, Ekfeldt A. Occlusal wear of teeth and restorative materials. A review of classification, etiology, mechanisms of wear, and some aspects of restorative procedures. *Acta Odontol Scand*. 1993;51:299–311.
38. Fayad MI. A literature review of vertical dimension in prosthodontics theory and practice - part 1: Theoretical foundations. *Cureus*. 2024;16:e61903.
39. Branco AC, ColaÇo R, Figueiredo-Pina CG, Serro AP. A state-of-the-art review on the wear of the occlusal surfaces of natural teeth and prosthetic crowns. *Materials (Basel)*. 2020;13:3525.
40. GÜth JF, Erdelt K, Keul C, et al. vivo wear of CAD-CAM composite versus lithium disilicate full coverage first-molar restorations: A pilot study over 2 years. *Clin Oral Investig*. 2020;24:4301–4311.
41. J FE-U, Hsu SM, BohÓrquez AC, et al. Novel methodology for measuring intraoral wear in enamel and dental restorative materials. *Clin Exp Dent Res*. 2020;6:677–685.
42. Seidel A, Belli R, Breidebach N, et al. The occlusal wear of ceramic fixed dental prostheses: 3-Year results in a randomized controlled clinical trial with split-mouth design. *J Dent*. 2020;103:103500.
43. Bronkhorst H, Kalaykova S, Huysmans M-C, et al. Tooth wear and bruxism: A scoping review. *J Dent*. 2024;145:104983.
44. Chrcanovic BR, Kisch J, Albrektsson T, Wennerberg A. Bruxism and dental implant treatment complications: A retrospective comparative study of 98 bruxer patients and a matched group. *Clin Oral Implants Res*. 2017;28:e1–e9.
45. Cardelli P, Manobianco FP, Serafini N, et al. Full-arch, implant-supported monolithic zirconia rehabilitations: Pilot clinical evaluation of wear against natural or composite teeth. *J Prosthodont*. 2016;25:629–633.
46. Tang Z, Zhao X, Wang H. Quantitative analysis on the wear of monolithic zirconia crowns on antagonist teeth. *BMC Oral Health*. 2021;21:94.
47. Dondani JR, Pardeshi V, Gangurde A, et al. Comparative evaluation of wear of natural enamel antagonist against glazed monolithic zirconia crowns and polished monolithic zirconia crowns: An in vivo study. *Int J Prosthodont*. 2023;36:273–281.
48. StÜck AV, Raith S, Reich S. Twenty-four months in vivo wear of enamel antagonists to lithium disilicate implant crowns - A pilot study. *J Dent*. 2022;124:104215.
49. Yang SW, Kim JE, Shin Y, et al. Enamel wear and aging of translucent zirconias: In vitro and clinical studies. *J Prosthet Dent*. 2019;121:417–425.
50. RodrÍguez Torres P, Galparsoro CatalÁn A, Riad Deglow E, et al. Digital technique to analyze the wear of screw-retained implant supported metal-ceramic dental prostheses and natural tooth as antagonist: A pilot study. *BMC Oral Health*. 2024;24:177.
51. Souza JCM, Silva CS, CaramÊs J, et al. Wear behavior of dental glass-ceramics: A scoping review on the damage of opposing tooth enamel surfaces. *Biotribology*. 2020;21:100116.
52. Flores-Ferreyra BI, Argueta-Figueroa L, Torres-Rosas R, et al. Dental human enamel wear caused by ceramic antagonists: A systematic review and network meta-analysis. *J Prosthodont Res*. 2025;69:153–162.
53. Jin C, Deng J, Pan P, et al. Comparative study on the impact-sliding wear behaviour of CAD/CAM resin-ceramic materials and tooth enamel. *Dent Mater*. 2023;39:25–40.
54. Youssef A, Hobeiche J, El Zoghbi A, et al. Bruxism and implant: where are we? A systematic review. *Bull Natl Res Cent*. 2022;46:172.
55. Larsson A, Manuh J, Chrcanovic BR. Risk factors associated with failure and technical complications of implant-supported single crowns: A retrospective study. *Medicina (Kaunas)*. 2023;59:1603.
56. Donker VJJ, Janss PEA, Pol CWP, et al. Mechanical performance of patient-specific prefabricated temporary shell versus laboratory-fabricated CAD/CAM provisional implant-supported single-tooth restorations: A laboratory study. *Clin Oral Implants Res*. 2024;35:1172–1179.
57. AlHamdan EM, Alsahhaf A, Alzahrani KM, et al. Clinical, radiographic peri-implant parameters and patient satisfaction with splinted and non-splinted short dental implants in the maxillary premolar-molar region: A long-term retrospective clinical study. *Oral Health Prev Dent*. 2023;21:291–296.
58. Popescu AM, Ionescu M, Popescu SM, et al. Oral clinical and radiological signs of excessive occlusal forces in Bruxism. *Diagnostics (Basel)*. 2025;15:702.
59. Woraganjanaboon P, Senawongse P, Anunmana C. A two-year clinical trial of enamel wear opposing 5Y-TZP and lithium disilicate crowns. *J Prosthet Dent*. 2025;133:747–755.
60. Mao Z, Beuer F, Hey J, et al. Antagonist enamel tooth wear produced by different dental ceramic systems: A systematic review and network meta-analysis of controlled clinical trials. *J Dent*. 2024;142:104832.
61. Mundhe K, Jain V, Pruthi G, Shah N. Clinical study to evaluate the wear of natural enamel antagonist to zirconia and metal ceramic crowns. *J Prosthet Dent*. 2015;114:358–363.
62. Verma A, Singh SV, Arya D, et al. Mechanical failures of dental implants and supported prostheses: A systematic review. *J Oral Biol Craniofac Res*. 2023;13:306–314.
63. Laumbacher H, Strasser T, KnÜttel H, Rosentritt M. Long-term clinical performance and complications of zirconia-based tooth- and implant-supported fixed prosthodontic restorations: A summary of systematic reviews. *J Dent*. 2021;111:103723.
64. Hmaidouch R, Weigl P. Tooth wear against ceramic crowns in posterior region: A systematic literature review. *Int J Oral Sci*. 2013;5:183–190.
65. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71.
66. Sterne JAC, Savović J, Page MJ, et al. RoB 2: A revised tool for assessing risk of bias in randomised trials. *BMJ*. 2019;366:l4898.
67. Sterne JA, HernÁn MA, Reeves BC, et al. ROBINS-I: A tool for assessing risk of bias in non-randomised studies of interventions. *Bmj*. 2016;355:i4919.
68. McGuinness LA, Higgins JPT. Risk-of-bias VISualization (robvis): An R package and Shiny web app for visualizing risk-of-bias assessments. *Res Synth Methods*. 2021;12:55–61.

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