



A comparative evaluation of survival and complication rates of all-ceramic and metal-ceramic single crowns in posterior region: A systematic review.

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ABSTRACT:

Introduction: All-ceramic and metal-ceramic crowns are widely used for posterior restorations. With advancements in ceramic materials such as zirconia and lithium disilicate, all-ceramic crowns offer improved esthetics and biocompatibility. However, concerns remain regarding their long-term survival and complication rates when compared with conventional metal-ceramic crowns. Systematic reviews evaluating their comparative clinical performance over extended follow-up periods are limited.

Objectives: The aim of this systematic review was to determine whether differences exist in the survival rates and complications of all-ceramic crowns when compared with metal-ceramic crowns in posterior teeth.

Methods: This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and was registered in the International prospective register for systematic reviews (CRD420251030683). The review was formulated to answer the research question: "Is there a difference in the survival rates and complications of all-ceramic crowns when compared with metal-ceramic crowns in posterior teeth?". An electronic search was performed in PubMed/MEDLINE, Google Scholar, Science Direct, and Cochrane databases. Clinical studies with a minimum follow-up of 5 years were included. The outcomes evaluated included survival rate, technical and biological complications. Data were analyzed qualitatively due to heterogeneity among studies.

Results: A total of 829 articles were identified by the search strategy, 5 of which were included in this review. Both all-ceramic and metal-ceramic crowns demonstrated high survival rates, with no statistically significant differences between the two groups. Technical complications, particularly veneering ceramic chipping, were more frequently associated with all-ceramic crowns, whereas metal-ceramic crowns exhibited fewer such complications. No significant differences were observed in overall survival rates or biological complications between the two materials.

Conclusions: All-ceramic crowns demonstrated clinical outcomes comparable to metal-ceramic crowns in posterior regions over a minimum follow-up period of 5 years. While differences in complication patterns exist, both materials can be considered reliable treatment options. Further long-term randomized clinical trials are required to strengthen the available evidence.



1. Introduction

Single-tooth full-coverage crowns represent one of the most definitive and functionally demanding treatment modalities in restorative and prosthodontic dentistry, particularly when placed in the posterior region. Posterior crowns are routinely subjected to the highest masticatory loads in the oral cavity, compounded by complex occlusal dynamics, lateral excursive forces, and the frequent presence of parafunctional habits such as bruxism. Unlike anterior restorations, failure of posterior crowns carries significant functional consequences, often compromising mastication, occlusal stability, and patient comfort. Consequently, the long-term success of posterior single crowns is determined by a delicate interplay of mechanical strength, fatigue resistance, marginal integrity, biological compatibility, and resistance to technical complications, making material selection a critical determinant of clinical outcome (1,2).

For several decades, metal-ceramic crowns (MCCs) have been regarded as the gold standard for posterior restorations due to their excellent fracture resistance, predictable clinical behavior, and long-term survival. Longitudinal clinical studies and systematic reviews have consistently demonstrated high survival rates for MCCs, often exceeding 90% at 10 years and remaining favorable even beyond 15 years (1,3,4). The metal substructure provides efficient stress distribution and structural stability, making MCCs particularly suitable for load-bearing posterior regions, even in patients with increased functional demands (5).

However, growing patient demand for metal-free restorations, increasing awareness of esthetic limitations associated with metal margins, concerns regarding metal hypersensitivity, and the rising cost of noble alloys have accelerated the shift toward all-ceramic crown systems (6,7). This transition has been further supported by advances in ceramic material science and CAD/CAM technology, which have enabled the development of high-strength ceramics such as lithium disilicate and zirconia, expanding the indications of all-ceramic crowns into posterior regions previously dominated by MCCs (7,8).

Among all-ceramic systems, zirconia-based crowns have gained widespread acceptance for posterior applications due to their superior flexural strength, transformation toughening, and favorable biocompatibility. Yttria-

stabilized tetragonal zirconia polycrystal (Y-TZP) ceramics demonstrate flexural strength values exceeding 900 MPa and high fracture toughness, theoretically enabling their use in high-stress posterior regions (6,9). Clinical studies and randomized controlled trials have reported promising outcomes for zirconia crowns, with survival rates comparable to metal-ceramic crowns at 3–5 years (4,10,11).

Nevertheless, the clinical performance of all-ceramic crowns in posterior regions remains controversial. While survival rates appear comparable, the nature and frequency of complications differ between all-ceramic and metal-ceramic restorations. Metal-ceramic crowns predominantly fail due to biological reasons such as secondary caries, endodontic complications, or tooth fracture, whereas all-ceramic crowns—particularly veneered zirconia systems—have been associated with higher rates of technical complications, including veneering porcelain chipping, delamination, and, less frequently, core fracture (3,4,10). Veneering ceramic chipping has consistently been reported as the most frequent technical complication of zirconia-based restorations, particularly in posterior load-bearing areas (4,12).

Recent evidence suggests that the introduction of monolithic ceramic crowns, particularly monolithic zirconia and lithium disilicate CAD-CAM restorations, has significantly reduced veneering-related failures. Monolithic designs eliminate the weak core–veneer interface and improve fatigue resistance under occlusal loading (13,14). Aziz and El-Mowafy (15) demonstrated higher success and survival rates with monolithic lithium disilicate crowns compared to metal-ceramic crowns over a 6-year follow-up, with significantly fewer technical complications and greater patient satisfaction. Similar favorable outcomes have been reported in other medium-term clinical studies evaluating monolithic zirconia crowns in posterior regions (14).

Importantly, posterior crowns are subjected to significantly higher functional loads than anterior restorations, making them more susceptible to fatigue-related failures and biological complications. Therefore, pooling anterior and posterior data or combining single crowns with fixed partial dentures and implant-supported restorations, as seen in several earlier reviews, may obscure material-specific performance patterns (2,3).



Systematic reviews by Pjetursson et al. (2007) and Sailer et al. (2015) (3,4) emphasized that weaker glass-based ceramics should be restricted to anterior regions, while zirconia-based crowns, although mechanically robust, exhibit distinct complication profiles that warrant careful evaluation when used posteriorly.

Furthermore, variations in tooth vitality, preparation design, finish-line configuration, cementation protocol, occlusal scheme, and patient-related factors such as bruxism significantly influence the survival and success of posterior crowns (10,11,14). These multifactorial influences underscore the need for focused analyses limited exclusively to posterior single crowns placed on natural teeth, using clearly defined survival and complication criteria.

2. Objectives

Given the expanding clinical use of all-ceramic restorations and the continued reliance on metal-ceramic crowns in posterior dentistry, a systematic comparison of survival rates and complication patterns is essential for evidence-based material selection. Understanding not only whether restorations survive, but also how and why they fail, is critical for optimizing long-term clinical outcomes and guiding prosthodontic decision-making.

Therefore, this systematic review aims to comparatively evaluate the survival and complication rates of all-ceramic and metal-ceramic single crowns in the posterior region, synthesizing available clinical evidence to provide clinically relevant, evidence-based recommendations for contemporary restorative practice

3. Methods

Protocol and registration

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (16). The protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under registration number CRD420251030683.

Focused question and PICO framework

The review was designed to answer the following research question: “Is there a difference in the survival rates and complication rates of all-ceramic crowns

compared with metal-ceramic crowns in posterior teeth?”

The research question was structured according to the PICO framework as follows:

- Population (P): Patients aged >17 years requiring full-coverage single crowns in posterior teeth (maxillary or mandibular)
- Intervention (I): All-ceramic crowns (including zirconia and lithium disilicate restorations)
- Comparison (C): Metal-ceramic crowns (porcelain-fused-to-metal restorations)
- Outcome (O): Survival rates and complication rates (technical complications such as chipping and fracture, and biological complications such as caries, periodontal changes, and tooth fracture)

Eligibility criteria

The eligibility criteria were defined prior to the commencement of the study.

Inclusion criteria:

Studies were included if they met the following criteria: randomized controlled trials, clinical trials, prospective and retrospective cohort studies, and observational studies; studies conducted on human participants aged >17 years; studies evaluating full-coverage all-ceramic and metal-ceramic single crowns in posterior teeth; studies with a minimum follow-up period of 5 years; studies reporting survival rates and/or technical and biological complications; studies published in English between January 2014 and December 2024; and studies in which restorations were tooth-supported and clinically evaluated.

Exclusion criteria:

Studies were excluded if they were *in vitro* studies, animal studies, reviews, opinion articles, case reports, abstracts, or duplicate publications; studies involving implant-supported crowns, fixed partial dentures, inlays, onlays, or veneers; studies lacking clear outcome measures; and studies based solely on questionnaires or patient records without clinical evaluation.

Information sources and search strategy

An electronic search was performed independently by two reviewers in PubMed/MEDLINE, Cochrane Central



Register of Controlled Trials (CENTRAL), Google Scholar, and ScienceDirect databases. The search was limited to studies published between January 1, 2014 and December 31, 2024, and restricted to English-language publications. A manual search was also performed in the Journal of Dentistry, Journal of Prosthetic Dentistry, Quintessence International, and Journal of Prosthodontics.

The search strategy included combinations of keywords and MeSH terms such as: “all-ceramic crowns,” “metal-ceramic crowns,” “zirconia crowns,” “survival rate,” and “complications,” combined using Boolean operators (AND, OR).

Study selection

All identified records were screened independently by two reviewers. Titles and abstracts were initially evaluated for relevance. Studies that did not meet the inclusion criteria were excluded. Full-text articles of the remaining studies were assessed for eligibility. Any disagreements between reviewers were resolved through discussion.

Data extraction

Data extraction was performed independently by two reviewers using a standardized data extraction form. The extracted data included study characteristics (author, year, study design), sample size, type of restorative material, follow-up duration, survival rates, and reported complications (mechanical and biological).

Risk of bias assessment

The methodological quality of the included studies was assessed independently by two reviewers. The included studies were evaluated for risk of bias (ROB) using the ROB 2.0 tool for randomized controlled trials and the ROBINS-I tool for nonrandomized trials.. Disagreements were resolved through discussion.

Data synthesis

Due to heterogeneity among the included studies in terms of design, outcome measures, and follow-up duration, a qualitative synthesis was performed. The results were summarized descriptively to compare survival rates and complication profiles between all-ceramic and metal-ceramic crowns.

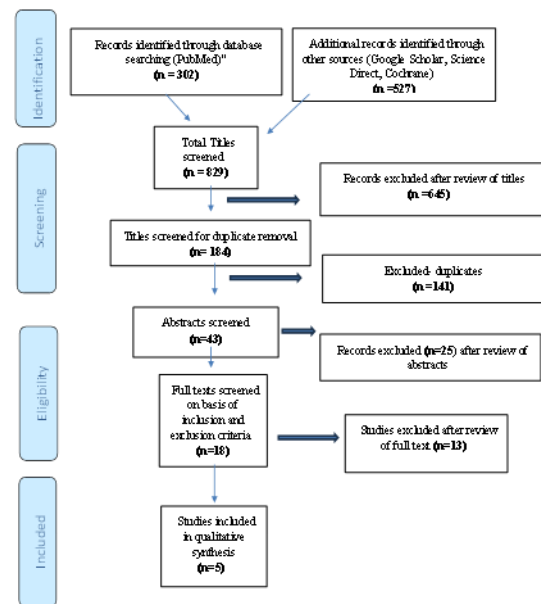


Figure 1: The Preferred Reporting Items for Systematic Reviews and Meta Analyses flowchart (16)

4. Results

The present systematic review was conducted to assess the survival rate and complications of all ceramic single crowns and to compare it with metal ceramic crowns in posterior region and to describe incidence of biological and technical complications. The screening process was undertaken in three steps that included screening of titles followed by screening of abstracts and finally screening of full text for inclusion in the review. The characteristics of the studies included in the systematic review are presented in the below tables.

Study id	Author	Year	Location	Study design	Sample size
1	Rinia S et al (14)	2015	Germany	Two-arm prospective clinical trial	N=91 (45 patients)
2	Monaco C et al (10)	2017	Italy	A randomized controlled clinical study.	N= 90 (72 patients)
3	Aziz A et al (15)	2022	Uae	Retrospective study	N=50 (25 patients)
4	Gonzalez-bonilla M et al (11)	2024	Spain	Retrospective cohort study	N=50 (34 patients)
5	D'souza NL et al (17)	2024	Canada	Retrospective chart review	N=403 patients

Table 1: Details of the studies included in the systematic review

Table 2 represents study characteristics with respect to age group, patients, intervention and comparator, outcomes and results of the included studies. The population across the studies consisted of patients, who



needed the covering of at least a molar and/or premolar, were included in the study. All teeth were endodontically treated, with absence of periapical lesion or active periodontitis. Patients with antagonistic teeth (vital or sufficiently endodontically treated) in the area of the restoration, vital abutments or abutments with sufficient endodontic treatment were also included.

The intervention/experimental group consisted of zirconia crowns and monolithic CAD-CAM lithium disilicate glass-ceramic (LDGC) crowns. The control/comparator group consisted of porcelain fused to metal/ meal ceramic crowns.

The primary outcomes assessed across the studies was the Clinical assessment of the crowns and the supporting periodontal structures were performed following the modified California Dental Association (CDA) criteria and survival of restorations using periapical radiographs, intraoral photographs, and USPHS modified criteria. The secondary outcomes were patients' preference was recorded using a visual analog scale (VAS), plaque index (PI) and gingival index (GI). The follow-up period was 6 months, 1-2-3-4 and 5 years after restoration placement to a maximum of 7 years.

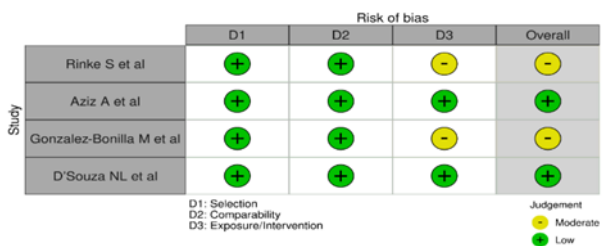
The results reported across the studies reported that Estimate Cumulative Survival (ECS) and the Estimate Cumulative Success (ECSs) with standard deviation (SE) were respectively 97.73 ± 2.19 and 92.64 ± 4.14 for zirconia-based crowns whereas 97.44 ± 2.39 and 91.11 ± 4.27 for porcelain fused to metal crowns. Furthermore, the 6-year cumulative survival rates for MC crowns and LDGC CAD-CAM were 90.8% and 96%, respectively, whereas the success rates were 83.4% and 96%, respectively. Moreover, the total number of crowns that survived was 471 (91.5%); 276 (90.1%) were metal-ceramic and 195 (93.3%) zirconia.

The conclusion of the majority of studies was zirconia molar crowns demonstrated a 5 year ECSv, ECSc and ECVCS comparable to MCCs. Irrespective of the fabrication technique, crowns on terminal abutments bear a significantly increased risk for VCFs. Furthermore, the survival of zirconia-based and metal-based single crowns is similar over a follow-up period of 5 years. No significant differences in esthetic, functional and biological outcomes were demonstrated between the two groups. Moreover, cemented crowns on vertical preparations show good clinical behaviour after 5 years.

The periodontal parameters (PI, GI, PD) of the Zr restorations are significantly better than those of PFM, with the exception of gingival recession.

Assessment of risk of bias

Risk of bias assessment of all the included studies was performed. For risk of bias assessment and quality assessment for Randomized controlled trial, Cochrane RoB2 tool was used with its domains, for retrospective and prospective studies, Newcastle Ottawa scale was used.



A) Risk of Bias assessment for Randomized controlled studies

The RoB2 tool revealed that the included study showed low risk of bias across all domains. The summary plot also showed 100% low risk of bias for all the domains. (Figure 2a and Figure 2b).

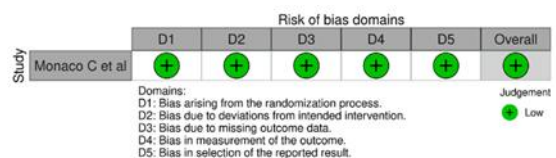


Figure 2a: Risk of bias traffic light plot using RoB-2 tool

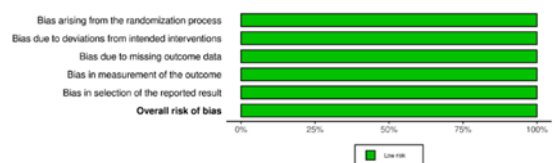


Figure 2b: RoB2 "Summary Plot" distribution of risk of bias among the studies

B) Risk of Bias for Retrospective and Prospective studies About 4 studies included in the systematic review were assessed for quality assessment by using the Newcastle Ottawa scale. The scale showed score of 6/9 and 7/9 for majority of the studies. This is due to the main issues being lack of adequate diagnosis, definition of



controls, and lack of adjustment for potential confounders (Table 3). (Figure 3a and Figure 3b).

S. No.	Authors	Year	Selection (Maximum, 4 Asterisks)	Comparability (Maximum, 2 Asterisks)	Exposure/Intervention (Maximum, 3 Asterisks)
1.	Rinke S et al	2015	***	**	**
2.	Aziz A et al	2022	***	**	***
3.	Gonzalez-Bonilla M et al	2024	***	**	**
4.	D'Souza NL et al	2025	***	**	***

Table 3: Study Quality as Assessed by the Newcastle Ottawa Scale as Judged by the 2 Reviewers Who Performed Data Extraction

Figure 3a: Risk of bias traffic light plot using New Castle Ottawa scale

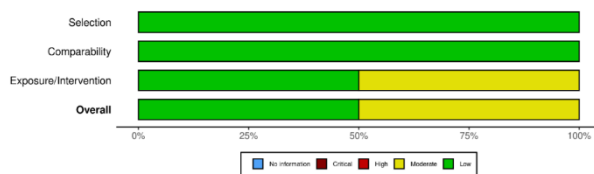


Figure 3b: RoB2 “Summary Plot” distribution of risk of bias among the studies



5. Discussion

The present systematic review aimed to comparatively evaluate the survival rates and complications associated with all-ceramic and metal-ceramic single crowns in the posterior region over a minimum follow-up of five years.

The findings across the included studies consistently demonstrate that both restorative materials exhibit high survival rates with no statistically significant differences, although variations exist in the type and frequency of complications.

Table 2- Details of the study participants, intervention, and comparator of the studies included in the systematic review

Sr. no	Author	Year	Location	Study design	Sample size	Population	Interventions/treatments used (Test group)	Comparator (Control group)	Follow-up period/Timeline duration	Primary outcomes	Secondary outcome, Any additional outcomes	Results	Conclusion
1	Rinke S et al	2015	Germany	two-arm prospective clinical trial	n=91 (45 patients)	Patients with antagonistic teeth (vital or sufficiently endodontically treated) in the area of the restoration, vital abutments or abutments with sufficient endontic	zirconia crowns (ZC)	metal-ceramic crowns (MCC)	5 years	Estimated cumulative survival (ECSv), success (ECSc) and veneering ceramic success (ECVCSc) were calculated	NR	Of the MCCs (n = 41), 85.0%, [95% -CI: (77%; 96%)] remained event-free, where as the ECSc for the ZCs (n = 50) was 74.3% (95% -CI):	In the present study, zirconia molar crowns demonstrated a 5 year ECSv, ECSc and ECVCSc comparable to MCCs. Irrespective of the fabrication



						treatm ent						[61%; 87%].	techni que, crown s on termin al abutm ents bear a signifi cantly increas ed risk for VCFs.
2	Mon aco C et al	20 17	Italy	a rando mized contr olled clinic al study.	n= 90 (72 pati ents)	patient s, who needed the coveri ng of at least a molar and/or premol ar, were includ ed in the study. All teeth were endod ontical ly treated , with absenc e of periapi cal lesion or active	45 single crowns with zirconia framework (ZirCad; Ivoclar Vivadent)	45 single crown s consis ting of a metal frame work (IPS d.SIG N 91; Ivocla r Vivad ent)	6 month s, 1-2- 3-4 and 5 years after restor ation place ment	surviv al of restora tions using periap ical radiog raphs, intraor al photo graphs , and USPH S modifi ed criteri a	NR	Estimate Cumulative Survival (ECS) and the Estimate Cumulative Success (ECS s) with stand ard deviat ion (SE) were respective ly 97.73 ±2.19 and 92.64 ±4.14	The presen t rando mized control led trial shows that the survival of zirconia- based and metal- based single crown s is similar over a follow -up period of 5 years. No signifi cant



						periodontitis.						for zirconia-based crowns where as 97.44 ±2.39 and 91.11 ±4.27 for porcelain fused to metal crowns.	differences in esthetic, functional and biological outcomes were demonstrated between the two groups
3	Aziz A et al	2022	UAE	retrospective study	n=50 (25 patients)	participants who had posterior or monolithic LDGC CAD-CAM and MC crowns placed in opposing quadrants of their mouths at the same time at the	monolithic CAD-CAM lithium disilicate glass-ceramic (LDGC) crowns	metal-ceramic (MC) crowns	6 years	Clinical assessment of the crowns and the supporting periodontal structures were performed following the modified California Dental Association	Patients' preference was recorded using a visual analog scale (VAS).	The 6-year cumulative survival rates for MC crowns and LDGC CAD-CAM were 90.8% and 96%, respectively, where as the	The high survival and success rates, low number of complications, and the high level of patients' acceptance of monolithic LDGC CAD-CAM crown



						Faculty of Dentistry for at least 6 years.				(CDA) criteria		success rates were 83.4% and 96%, respectively.	send them well as predictable and viable alternatives to the "gold standard" MC crowns
4	Gonzalez-Bonilla M et al	2024	Spain	retrospective cohort study	n=50 (34 patients)	patients treated with a PFM or Zr unitary full-coverage crown on molar or premolar teeth prepared with a vertical finishing line, older than 18 years, non-	25 zirconia-based (Zr)	25 porcelain-fused-to-metal (PFM)	5.6 years	restorations were evaluated according to the California Dental Association (CDA) Quality Criteria, and periodontal variables were studied in the abutment teeth compa	plaque index (PI) and gingival index (GI)	At 66 months, the success rates for PFM and Zr crowns were 85.7% and 100%, respectively	Cemented crowns on vertical preparations show good clinical behavior after 5 years. The periodontal parameters (PI, GI, PD) of the Zr restorations are significantly



						smoke rs				red with the unrest ored contra lateral teeth.			better than those of PFM, with the except ion of gingiv al recessi on.
5	D'S ouza NL et al	20 24	Can ada	retros pectiv e chart revie w	n=4 03 pati ents	electro nic health record (EHR) system (axiU m Acade mic Dental Softwa re; Exan Softwa re) of all single monoli thic (3-4Y) zirconi a crowns and metal- cerami c crowns	zirconi (n=209) and	metal- ceram ic (n=30 6) crown s	7 years	failur , causes for failur , and compl ication s associ ated with surviv al.	NR	Tooth fractu re (50.0 %) specif ically was found to be the most frequ ent cause of failur e, $\chi^2(3)=$ 21.27 , P<.00 1. The total numb er of crown s that survi ved was 471	Within the study follow -up time, the surviv al of monoli thic zirconi a and metal- cerami c crown s was 91.5%, with similar clini cal compli cations between groups . Biolog ical compli cations ,



significantly reduces the risk of chipping, which has historically been a major limitation of bilayered zirconia systems (19,20).

Periodontal outcomes also appear to favor all-ceramic restorations in some cases. Gonzalez-Bonilla et al. reported better periodontal parameters, including lower plaque accumulation and reduced gingival inflammation, in zirconia crowns compared to metal-ceramic crowns, although gingival recession was slightly higher in zirconia restorations (11). This may be attributed to the superior biocompatibility and smoother surface characteristics of zirconia (18).

Esthetic performance is another critical factor influencing material selection. All-ceramic crowns offer superior translucency and eliminate the risk of gingival discoloration associated with metal frameworks. (20). This has led to increased patient preference for all-ceramic restorations, as also reported by Aziz and El-Mowafy (15).

Despite these advantages, metal-ceramic crowns continue to be regarded as the gold standard due to their long-term clinical success and mechanical reliability. (21,22). Their resistance to fracture and predictable performance make them particularly suitable for high-load posterior regions and patients with parafunctional habits (23,24).

However, the findings of this review should be interpreted with caution due to heterogeneity among included studies in terms of study design, sample size, follow-up duration, and evaluation criteria. Additionally, the limited number of long-term randomized controlled trials highlights the need for further high-quality evidence.

Overall, this systematic review suggests that all-ceramic crowns, particularly zirconia and lithium disilicate systems, are viable and predictable alternatives to metal-ceramic crowns in posterior regions. While survival rates are comparable, the choice of material should be individualized based on esthetic requirements, functional demands, and patient-specific factors.

6. Conclusion

Within the limitations of this systematic review, it can be concluded that all-ceramic single crowns, including zirconia and lithium disilicate restorations, demonstrate

survival rates comparable to conventional metal-ceramic crowns in the posterior region over a follow-up period ranging from 5 to 7 years.

The evidence indicates that there are no significant differences in overall clinical performance, including survival, success rates, and incidence of technical complications, between the two crown systems. However, all-ceramic crowns, particularly zirconia-based restorations, may offer improved periodontal outcomes and higher patient satisfaction, making them a favorable alternative in clinical practice.

Biological complications, especially tooth fracture, were observed in both groups and remain a significant factor influencing long-term prognosis, irrespective of the crown material.

Despite encouraging findings, the heterogeneity in study designs, variations in sample sizes, and limited number of high-quality randomized controlled trials necessitate cautious interpretation of results.

Therefore, further well-designed long-term randomized controlled trials with standardized outcome measures are recommended to strengthen the evidence base and support definitive clinical decision-making.

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