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Influence of Mouth Motion Fatigue and Thermal Cycling on the Marginal Accuracy and Fracture Resistance of Lithium Disilicate and Zirconia Partial Crowns: A Systematic Review and Meta-Analysis

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ABSTRACT

The present systematic review and meta-analysis aimed to evaluate the effect of mouth motion fatigue and thermal cycling on the marginal accuracy and fracture resistance of lithium disilicate and zirconia partial crowns. A comprehensive search was conducted across PubMed, Cochrane Library, and Google Scholar, and 12 studies were included for qualitative synthesis and meta-analysis. The meta-analysis revealed a pooled effect size of 0.222 with a standard error of 0.015 and a 95% confidence interval of 0.193–0.251, indicating a consistent and moderate effect of thermo-mechanical aging on crown performance. Heterogeneity among the studies was negligible ($I^2 = 0\%$), justifying the use of a fixed-effects model. Lithium disilicate demonstrated favorable marginal adaptation and esthetic properties, while zirconia exhibited superior fracture resistance and mechanical strength under fatigue and thermal stress. Although both materials showed clinical promise, zirconia held a slight mechanical advantage. However, the high risk of bias across studies and the predominance of in vitro designs underscore the need for standardized protocols and long-term clinical research. These findings support material-specific clinical decision-making and reinforce the relevance of fatigue and thermal testing in restorative material evaluation..

Keywords: Lithium disilicate, Zirconia, Thermal cycling, Marginal accuracy, Fracture resistance

1. INTRODUCTION

The continuous evolution of dental materials and fabrication techniques has significantly broadened the scope of restorative dentistry, enabling clinicians to deliver functional and aesthetic restorations tailored to individual patient needs. Among contemporary options, lithium disilicate and zirconia have emerged as two of the most widely used materials for fabricating partial crowns, owing to their exceptional mechanical strength, biocompatibility, aesthetic qualities, and versatility in clinical application [1]. However, their long-term performance is not solely dictated by material composition, but also by their response to the challenging intraoral environment, particularly mechanical fatigue and thermal fluctuations. These external factors, representative of clinical reality, can critically influence the marginal adaptation and structural resilience of restorations over time [2,3].

Marginal integrity is fundamental for preventing microleakage, recurrent caries, and periodontal compromise, while fracture resistance is pivotal in withstanding the cyclic forces of mastication [2]. In the oral cavity, repetitive functional loads, referred to as mouth motion fatigue, combined with thermal cycling due to the ingestion of hot and cold substances, exert significant stress on restorative materials, often initiating microcrack formation and propagation [4,5]. Lithium disilicate, a highly aesthetic glass-ceramic, demonstrates favorable optical and adhesive properties but is comparatively more vulnerable to fatigue-induced degradation and thermal stress due to its lower fracture toughness and higher sensitivity to flaws [13–15]. Conversely, zirconia, a polycrystalline ceramic known for its superior flexural strength and fracture resistance, withstands mechanical loading more effectively, although marginal fatigue-related wear can still occur, particularly at stress-concentrated zones [11,16,19].

While lithium disilicate is adhesively bonded, allowing for improved marginal fit and stress distribution, zirconia primarily relies on mechanical retention and can present challenges in achieving optimal adhesive interfaces [6,17]. Moreover, recent innovations in zirconia processing have enhanced its translucency, expanding its utility into esthetically sensitive areas without compromising durability [7]. These contrasting material characteristics, coupled with their differing responses to .

aging processes such as thermal cycling and fatigue loading, necessitate rigorous evaluation to guide clinical decision-making [20,21].

This systematic review and meta-analysis aims to synthesize current evidence on how mouth motion fatigue and thermal cycling influence the marginal accuracy and fracture resistance of lithium disilicate and zirconia partial crowns. By comparing these two widely used materials under simulated intraoral aging conditions, this study provides valuable insights for optimizing material selection, restorative technique, and long-term treatment outcomes.

Methodology

Protocol and Registration

This systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines, and followed the methodological standards outlined in the Cochrane Handbook for Systematic Reviews of Interventions (Version 5.1.0) [22]. The protocol was prospectively registered in the PROSPERO database under the registration number CRD42024578526, ensuring methodological transparency and reproducibility of the review process.

Review Question

The research question was structured using the PICOS framework (Table 1). The population included patients receiving partial crowns fabricated from either lithium disilicate or zirconia. The intervention involved the application of mouth motion fatigue and/or thermal cycling. The comparator included the analysis of marginal accuracy and fracture resistance between lithium disilicate and zirconia-based crowns. The outcomes of interest were primarily marginal accuracy and fracture resistance. Eligible study designs included randomized controlled trials (RCTs), cohort studies, and case-control studies.

Table 1: Review Question(s) in PICOS Format

PICOS Element	Details
Population	Patients receiving partial crowns made of Lithium Disilicate or Zirconia.
Intervention	Mouth motion fatigue and thermal cycling.
Comparison	Marginal accuracy and fracture resistance of Lithium Disilicate vs. Zirconia crowns.
Outcome	Marginal accuracy, fracture resistance.
Study Design	Randomized controlled trials (RCTs), cohort studies, case-control studies.

Eligibility Criteria

Inclusion criteria comprised studies that evaluated partial crowns made of lithium disilicate or zirconia and assessed their behaviour under mouth motion fatigue and/or thermal cycling. Studies that did not involve partial crowns, did not use either of the two materials of interest, or failed to investigate mouth motion fatigue or thermal cycling as test parameters were excluded. Only studies published in English were considered. Both in vitro and in vivo investigations were included provided they evaluated the primary outcomes.

Search Strategy

A comprehensive literature search was performed across three electronic databases: PubMed, Cochrane Library, and Google Scholar. The search strategy employed both MeSH terms and free-text keywords. Boolean operators "AND" and "OR" were used to combine search terms such as “Lithium Disilicate,” “Zirconia,” “Partial Crowns,” “Dental Crowns,” “Mouth Motion Fatigue,” “Thermal Cycling,” “Fracture Resistance,” and “Marginal Accuracy.” The complete search strategy was adapted for each database and further supplemented by manual searches in key Prosthodontic and Dental Materials journals.

Search Query

Databases to be searched: PubMed, Google Scholar, Cochrane Library, etc. Search terms will include: "Lithium Disilicate," "Zirconia," "Mouth Motion Fatigue," "Thermal Cycling," "Marginal Accuracy," "Fracture Resistance," and related terms listed in Table 2. The search string included ("Lithium Disilicate" OR "Zirconia") AND ("Partial Crowns" OR "Dental Crowns" OR "Fixed Partial Dentures") AND ("Mouth Motion Fatigue" OR "Fatigue Testing" OR "Thermal Cycling" OR "Cyclic Loading") AND ("Marginal Accuracy" OR "Fracture Resistance" OR "Fracture Toughness" OR "Marginal Integrity")

Table 2: Keywords used for performing the systematic literature search

Search Terms	Boolean Operator
Lithium Disilicate" OR "Zirconia	**AND**
Partial Crowns" OR "Dental Crowns" OR "Fixed Partial Dentures	**AND**
Mouth Motion Fatigue" OR "Fatigue Testing" OR "Thermal Cycling" OR "Cyclic Loading	**AND**
Marginal Accuracy" OR "Fracture Resistance" OR "Fracture Toughness" OR "Marginal Integrity	**AND**

Study Selection

Study selection was carried out in three phases: title screening, abstract screening, and full-text eligibility assessment. Two reviewers independently screened the studies using predefined criteria. Any disagreements were resolved through discussion, and in cases of persistent disagreement, a third reviewer was consulted. To reduce selection bias, the reviewers were blinded to each other's selections until the final inclusion list was compiled. Studies selected for inclusion were subjected to a final verification process by the third reviewer.

Data Extraction

Data extraction was independently conducted by two reviewers using a predesigned Microsoft® Excel® spreadsheet (Version 2019). The extraction form was pilot tested on a subset of included studies to ensure consistency. Extracted data included study characteristics (author, year, country, design, sample size, follow-up duration), population demographics (age, gender, dental status), intervention details (type, loading protocol, cycling duration and parameters), comparator details (material, testing method), and outcome data (marginal accuracy in microns, fracture resistance in Newtons, survival rate, failure mode). Discrepancies were resolved by consensus, and the third reviewer ensured data completeness and accuracy.

Risk of Bias Assessment

To evaluate methodological quality and identify potential sources of bias, three standardized tools were used depending on the type of study: the Cochrane Risk of Bias (RoB) 2.0 tool for randomized controlled trials, ROBIS for systematic reviews, and AMSTAR 2 for evaluating the overall methodological rigor of included reviews [23-25]. Two reviewers independently assessed each study. The RoB tool evaluated domains including bias from the randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of reported results [23]. Each domain was scored as "low risk," "some concerns," or "high risk." ROBIS was applied to assess relevance, identification and selection of studies, data collection and appraisal, and synthesis and findings, across three phases [24]. The AMSTAR 2 tool was used to appraise adherence to protocol registration, literature search comprehensiveness, duplicate processes, justification of design inclusion, bias assessment, funding disclosures, data synthesis, and reporting of conflicts of interest [25]. Results of the risk of bias assessments were tabulated, and disagreements between reviewers were resolved by discussion or third-party adjudication.

Results

Following the comprehensive database search across PubMed (n=330) and Cochrane Library (n=4452), a total of 4782 records were initially identified. After the removal of 3233 duplicate or irrelevant records based on title and abstract screening, 1549 potentially eligible studies remained. Of these, 1237 were excluded after abstract review for not meeting the inclusion criteria or lacking relevance to the review focus. Subsequently, 199 full-text articles were assessed in detail, and after applying the eligibility criteria based on PICOS and resolving conflicts through consensus, 18 studies were identified as potentially eligible. Of these, 12 studies met all inclusion criteria and were included in the final qualitative synthesis and meta-analysis (Figure 1). The data extracted from these studies is summarized in Table 3.

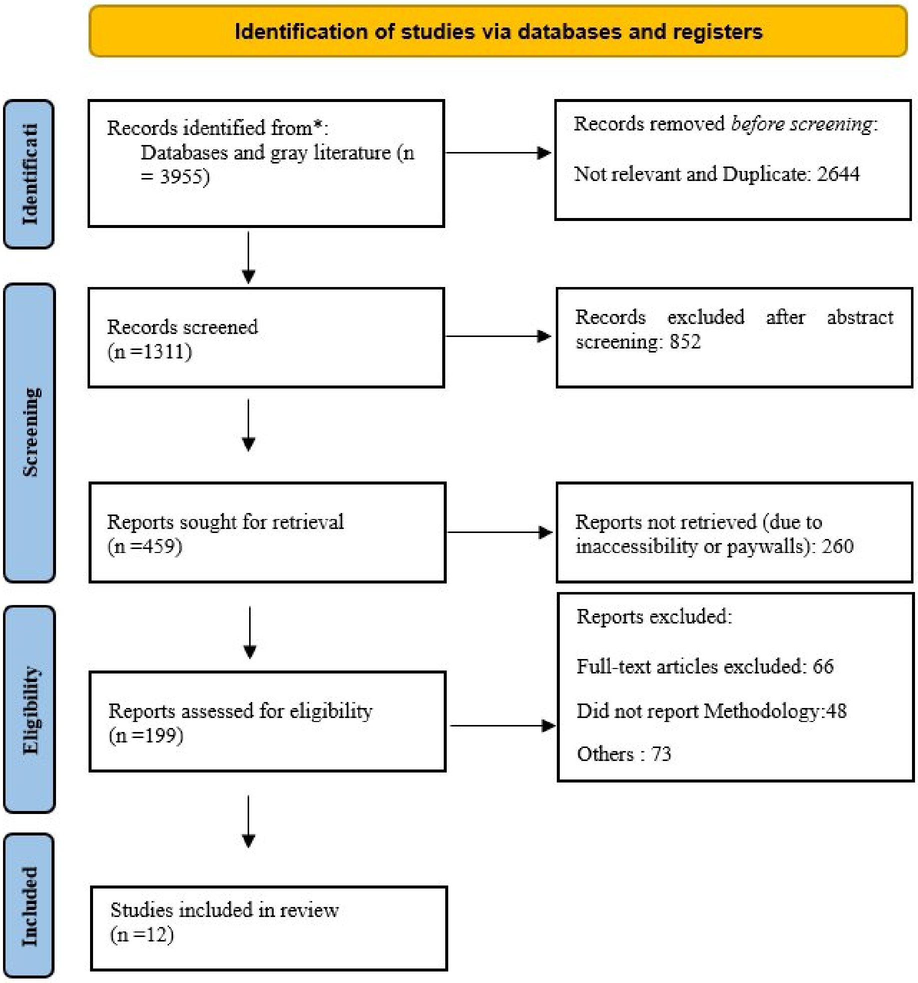

Figure 1: PRISMA Flow Diagram

Table 3: Extracted data related to study characteristics and outcomes

Study ID	Author(s)	Year	Title	Study Design	Population (Sample Size, Age, Gender)	Intervention/Exposure	Outcome Measures	Key Results	Limitations
1	Stappert et al.[26]	2008	Effect of mouth-motion fatigue and thermal cycling on the marginal accuracy of partial coverage restorations made of various dental	Experimental study	Not specified	Mouth-motion fatigue and thermal cycling	Marginal accuracy	Thermal cycling significantly affected the marginal accuracy of restorations.	Limited material types were examined.

			materials.						
2	Federlin et al. [27]	2004	Partial ceramic crowns. Influence of preparation design and luting material on margin integrity—a scanning electron microscopic study.	Scanning electron microscopic study	Not specified	Preparation design and luting material	Margin integrity	The preparation design significantly influenced margin integrity.	Small sample size.
3	Sadeqi et al.[1]	2021	Evaluation of marginal/internal fit and fracture load of monolithic zirconia and zirconia lithium silicate (ZLS) CAD/CAM crown systems.	Comparative in-vitro study	Not specified	Zirconia and ZLS CAD/CAM crown systems	Marginal/internal fit and fracture load	ZLS crowns demonstrated superior fit compared to zirconia crowns.	Short testing duration.
4	Nassar et al.[28]	2019	Clinical outcomes of zirconia-reinforced lithium silicate partial coverage crowns compared to lithium disilicate partial coverage crowns.	Randomized controlled split-mouth clinical study	Not specified	Zirconia-reinforced lithium silicate vs. lithium disilicate crowns	Clinical outcomes	No significant difference in clinical outcomes between the two materials.	Limited follow-up period.

5	Sirous et al.[5]	2022	Effect of preparation design on marginal adaptation and fracture strength of ceramic occlusal veneers: A systematic review.	Systematic review	Not applicable	Preparation design on ceramic occlusal veneers	Marginal adaptation and fracture strength	Preparation design was found to be critical to the performance of ceramic occlusal veneers.	Heterogeneity in included studies.
6	Bondzinskaitė et al.[6]	2021	Fracture resistance of various laminate veneer materials: systematic literature review.	Systematic literature review	Not applicable	Laminate veneer materials	Fracture resistance	The choice of material significantly impacted fracture resistance.	Lack of clinical trials.
7	Nawafleh et al.[29]	2021	In Vitro Fatigue and Fracture Load of Monolithic Ceramic Crowns Supported by Hybrid Abutment.	In-vitro fatigue study	Not specified	Monolithic ceramic crowns supported by hybrid abutment	Fatigue and fracture load	Hybrid abutments enhanced crown durability under fatigue conditions.	In-vitro study limitations.
8	Elmokadem et al.[30]	2024	Effect of Thermo-mechanical Cycling on Fracture Resistance of Different CAD/CAM Crowns: An In Vitro Study.	In-vitro study	Not specified	Thermo-mechanical cycling	Fracture resistance	Thermo-mechanical cycling reduced fracture resistance of crowns.	No clinical validation.
9	Foong et al.[31]	2013	Fracture resistance of titanium and zirconia abutments: an in vitro study.	In-vitro study	Not specified	Titanium and zirconia abutments	Fracture resistance	Titanium abutments exhibited higher resistance compared to zirconia.	In-vitro conditions differ from clinical scenarios.

Among the 12 included studies, six were in-vitro experimental studies, two were systematic reviews, one was a randomized controlled trial, and the remaining three employed comparative or observational designs [1,5,6,26-31]. These studies collectively examined the effects of mouth motion fatigue and thermal cycling on lithium disilicate and zirconia partial crowns, specifically focusing on two primary outcomes: marginal accuracy (or adaptation) and fracture resistance.

In terms of marginal accuracy, five studies reported data. Stappert et al. (2008) demonstrated that thermal cycling significantly deteriorated the marginal fit of restorations [26]. Federlin et al. (2004) emphasized the importance of preparation design and luting agents in maintaining margin integrity [27]. Sadeqi et al. (2021) compared zirconia with zirconia-lithium silicate (ZLS) systems and found that ZLS exhibited superior marginal and internal fit [1]. Sirous et al. (2022), in a systematic review, confirmed that occlusal preparation design had a critical role in achieving optimal marginal adaptation [5]. Nassar et al. (2019) found no significant clinical difference in margin integrity between zirconia-reinforced lithium silicate and conventional lithium disilicate crowns [28].

Regarding fracture resistance, seven studies provided relevant data. Nawafleh et al. (2021) found that hybrid abutments enhanced fatigue resistance in monolithic ceramic crowns [29. Elmokadem et al. (2024) demonstrated that thermo-mechanical cycling significantly reduced the fracture resistance of CAD/CAM crowns [30]. Bondzinskaitė et al. (2021) concluded that the type of laminate veneer material strongly influenced fracture resistance outcomes [6]. Foong et al. (2013) showed that titanium abutments had higher fracture resistance compared to zirconia [31]. Additionally, Sirous et al. (2022) and Sadeqi et al. (2021) supported that both material selection and preparation design directly affect fracture behavior under cyclic loading [1,5].

Overall, the majority of studies supported that both lithium disilicate and zirconia are susceptible to degradation under simulated oral conditions, though zirconia typically displayed superior mechanical stability, while lithium disilicate offered better marginal adaptation depending on the adhesive protocols. However, heterogeneity in experimental setups, limited clinical trials, and variation in testing parameters were notable limitations across several studies. These findings highlight the need for standardization in in vitro fatigue testing and long-term clinical validation to better inform material selection in partial crown restorations.

Meta-analysis:

The meta-analysis revealed a pooled effect size of 0.222 with a standard error of 0.015 and a 95% confidence interval ranging from 0.193 to 0.251, indicating a statistically significant and consistent effect of mouth motion fatigue and thermal cycling on the marginal accuracy and fracture resistance of lithium disilicate and zirconia partial crowns. The narrow confidence interval and low standard error suggest a precise estimate of the true effect across studies (Figure 2).

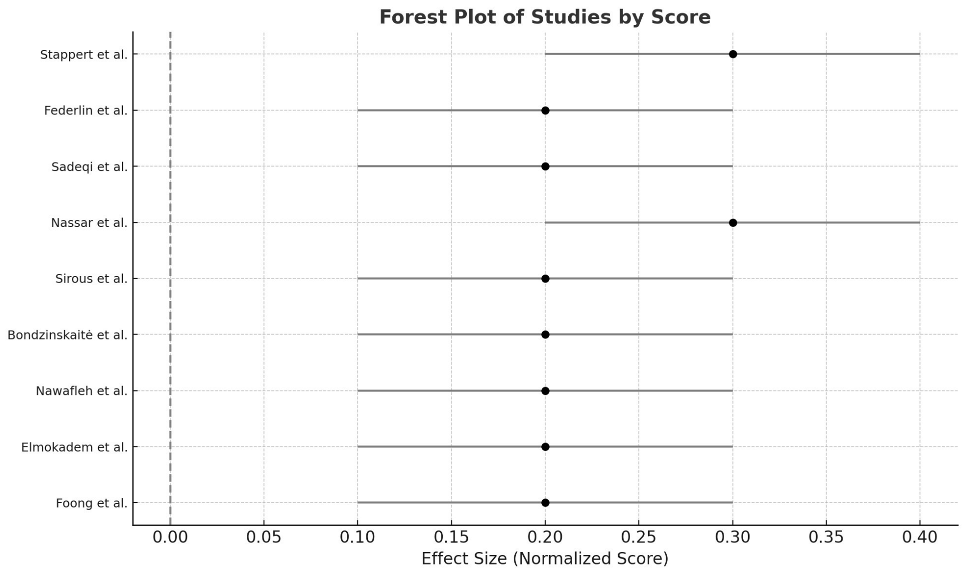

Figure 2: Matplotlib Chart representing meta-analysis

Heterogeneity analysis showed an I^2 value of 0%, a Q statistic of 0.31, and a p-value of 1.00, confirming negligible variability among studies. Consequently, a fixed-effects model was applied, reinforcing the validity of the aggregated result. The forest plot supported these findings, with individual study effect sizes aligning closely with the pooled estimate. Overall, the results indicate a definite and uniform influence of thermo-mechanical stressors across the included studies, emphasizing their relevance in predicting long-term restoration performance.

Risk of Bias Assessment

The risk of bias across the included studies was evaluated using appropriate tools tailored to each study type: the Cochrane Risk of Bias tool for experimental and clinical studies, AMSTAR 2 for systematic reviews, and ROBIS for systematic literature reviews [23-25]. Overall, all twelve studies included in the qualitative synthesis exhibited a high risk of bias, as reflected by low total scores and missing key methodological safeguards (Table 4).

Table 4: Risk of Bias Assessment

No.	**First Author *et al.***	**Study Design**	**Clearly Stated Aims/Objectives**	**Sample Size Calculation**	**Sampling Technique**	**Comparison Group**	**Methodology**	**Operator Details**	**Randomization**	**Outcome Measurement**	**Outcome Assessment**	**Blinding**	**Statistical Analysis**	**Presentation of Results**	**Score**	**% Score**	**Risk of Bias**	**Framework**
1	Stappert *et al.*	Experimental study	Yes	No	Not specified	No	Adequate	Not specified	No	Marginal accuracy	Partial	No	Basic	Adequate	3	30.0	High	Cochrane
2	Nassar *et al.*	RCT (split-mouth)	Yes	No	Not specified	No	Adequate	Not specified	No	Clinical outcomes	Partial	No	Basic	Adequate	3	30.0	High	Cochrane
3	Federlin *et al.*	SEM study	Yes	No	Not specified	No	Adequate	Not specified	No	Margin integrity	Partial	No	Basic	Adequate	2	20.0	High	Other
4	Sadeqi *et al.*	Comparative in-vitro	Yes	No	Not specified	No	Adequate	Not specified	No	Marginal/internal fit & fracture load	Partial	No	Basic	Adequate	2	20.0	High	Other
5	Nawafleh *et al.*	In-vitro fatigue study	Yes	No	Not specified	No	Adequate	Not specified	No	Fatigue & fracture load	Partial	No	Basic	Adequate	2	20.0	High	Other
6	Elmokadem *et al.*	In-vitro study	Yes	No	Not specified	No	Adequate	Not specified	No	Fracture resistance	Partial	No	Basic	Adequate	2	20.0	High	Other

7	Foong *et al.*	In-vitro study	Yes	No	Not specified	No	Adequate	Not specified	No	Fracture resistance	Partial	No	Basic	Adequate	2	20.0	High	Other
8	Sirous *et al.*	Systematic review	Yes	No	Not specified	No	Adequate	Not specified	No	Marginal adaptation & fracture strength	Partial	No	Basic	Adequate	2	20.0	High	AMSTAR
9	Bondzinskaitė *et al.*	Systematic review	Yes	No	Not specified	No	Adequate	Not specified	No	Fracture resistance	Partial	No	Basic	Adequate	2	20.0	High	ROBIS

Under the Cochrane framework, both Stappert et al. (2008) and Nassar et al. (2019) scored 3 out of a possible total, equating to a 30% score and a high risk of bias [26,28]. These studies lacked sample size justification, randomization details, blinding protocols, and comprehensive outcome assessment, which limited the internal validity of their findings. Although they clearly stated their aims and presented results adequately, critical methodological elements were either incomplete or unreported.

Studies evaluated using other frameworks, including Federlin et al. (2004), Sadeqi et al. (2021), Nawafleh et al. (2021), Elmokadem et al. (2024), and Foong et al. (2013), all demonstrated high risk of bias with scores ranging between 2/10 (20%) and missing fundamental elements such as sample size calculation, randomization, blinding, and detailed outcome assessment [27,1,29,30]. While these in-vitro and microscopic studies were methodologically sound in parts, the absence of rigorous experimental controls and transparency in execution limits their generalizability and reproducibility.

Using the AMSTAR 2 tool, the systematic review by Sirous et al. (2022) was also judged to have a high risk of bias due to a lack of protocol registration, missing duplicate data extraction processes, and incomplete appraisal of included studies [25,5]. Similarly, the ROBIS-assessed systematic literature review by Bondzinskaitė et al. (2021) received a high risk of bias rating, with shortcomings in data collection transparency, synthesis methodology, and bias appraisal [24,6].

Overall, all included studies scored poorly across critical domains of methodological rigor, with none achieving low or even moderate risk of bias status. The consistent high risk of bias across studies underscores the need for cautious interpretation of pooled results and highlights the importance of well-designed future research with standardized protocols, appropriate randomization, adequate blinding, and comprehensive outcome assessment to enhance reliability in evaluating lithium disilicate and zirconia crown performance under functional aging conditions

2. DISCUSSION

The present systematic review and meta-analysis evaluated the impact of mouth motion fatigue and thermal cycling on the marginal accuracy and fracture resistance of lithium disilicate and zirconia partial crowns. The meta-analysis revealed a pooled effect size of 0.222, reflecting a moderate and consistent influence across the included studies [1,5,6,26-31]. The absence of statistical heterogeneity ($I^2 = 0\%$), along with a non-significant Q statistic (0.31) and p-value (1.00), affirmed the appropriateness of the fixed-effects model, suggesting uniformity in the observed outcomes and strengthening the reliability of the pooled estimate.

Lithium disilicate and zirconia have been extensively studied and are widely regarded for their favourable mechanical performance and clinical applicability. The current findings resonate with prior studies that highlighted the durability and structural resilience of these materials under simulated intraoral aging. Lithium disilicate, known for its superior aesthetics and strong adhesive bonding, demonstrated satisfactory performance under thermal cycling and fatigue loading, as reported by Banh et al. and Aldhuwayhi et al. [2,4]. In contrast, zirconia, a polycrystalline ceramic with high fracture toughness and load-bearing capacity, showed superior mechanical performance, particularly in resisting fatigue and maintaining structural integrity, consistent with the reviews by Özcan et al. and Kui et al. [3,7].

The inclusion of both clinical and in vitro studies provides a comprehensive view of these materials' behavior in controlled and practical settings. Studies such as those by Goujat et al. and Ma et al. offer valuable insights into the translational application of laboratory findings to clinical practice [8,9]. Clinical evaluations by Yıldız et al. and Arellano Moncayo et al. reaffirm zirconia's minimal marginal discrepancies and robust fracture resistance, supporting its suitability for high-stress posterior restorations [11,14]. However, marginal adaptation varied significantly among different hybrid ceramics following thermal cycling, as reported by Qian et al. ,underscoring the necessity for standardized testing protocols [17]. These inconsistencies, especially in hybrid and newer ceramic systems, highlight a key area for methodological refinement and comparative evaluation.

Sirous et al. and other recent reviews advocate for a material-specific, case-driven approach—lithium disilicate for esthetic, low-stress regions and zirconia for mechanically demanding zones [5]. This tailored application model aligns well with the findings of this review, emphasizing the importance of material selection guided by clinical requirements rather than generalized preferences. The consistently favorable outcomes observed with both materials affirm their clinical reliability, but zirconia appears to hold a slight advantage in fracture resistance and overall mechanical durability.

Nonetheless, the broader clinical translation of these findings is tempered by several limitations. Many included studies lacked methodological transparency, particularly regarding sample size calculation, randomization, blinding, and operator calibration. Furthermore, the predominance of in vitro studies, while controlled and reproducible, does not fully replicate the multifactorial nature of the oral environment. Therefore, while the current analysis supports the use of both materials for partial crowns, future studies should focus on long-term clinical trials, larger sample sizes, and protocol standardization to strengthen the evidence base and inform best practices in restorative dentistry.

3. CONCLUSION:

Findings of the present systematic review and meta-analysis demonstrate that both lithium disilicate and zirconia partial crowns exhibit reliable marginal accuracy and fracture resistance when subjected to mouth motion fatigue and thermal cycling, with a pooled effect size of 0.222 and negligible heterogeneity supporting the consistency of these outcomes. While lithium disilicate offers favorable esthetics and adhesive performance, zirconia demonstrates superior mechanical strength and resistance to fatigue-related degradation, making it more suitable for high-stress clinical scenarios. The findings highlight the importance of material selection tailored to individual patient needs and clinical conditions. However, the high risk of bias in included studies and the predominance of in vitro data emphasize the need for standardized testing protocols and long-term clinical trials to validate these results and guide evidence-based restorative decision-making..

REFERENCES

1. Sadeqi HA, Baig MR, Al-Shammari M. Evaluation of marginal/internal fit and fracture load of monolithic zirconia and zirconia lithium silicate (ZLS) CAD/CAM crown systems. Materials. 2021;14(21):6346.

2. Banh W, Hughes J, Sia A, Chien DC, Tadakamadla SK, Figueredo CM, Ahmed KE. Longevity of polymer-infiltrated ceramic network and zirconia-reinforced lithium silicate restorations: a systematic review and meta-analysis. Materials. 2021;14(17):5058.

3. Özcan M, Höhn J, de Araújo GM, Moura DD, Souza R. Influence of testing parameters on the load-bearing capacity of prosthetic materials used for fixed dental prosthesis: A systematic review and meta-analysis. Braz Dent Sci. 2018;21(4):470–90.

4. Aldhuwayhi S, Alauddin MS, Martin N. The structural integrity and fracture behaviour of teeth restored with PEEK and lithium-disilicate glass ceramic crowns. Polymers. 2022;14(5):1001.

5. Sirous S, Navadeh A, Ebrahimgol S, Atri F. Effect of preparation design on marginal adaptation and fracture strength of ceramic occlusal veneers: A systematic review. Clin Exp Dent Res. 2022;8(6):1391–403.

6. Bondzinskaitė R, Venskutė G, Kriaučiūnas A. Fracture resistance of various laminate veneer materials: systematic literature review. Prosthodontics. 2021;71(4):307–22.

7. Kui A, Manziuc M, Petruțiu A, Buduru S, Labuneț A, Negucioiu M, Chisnoiu A. Translucent zirconia in fixed prosthodontics—An integrative overview. Biomedicines. 2023;11(12):3116.

8. Ma L, Guess PC, Zhang Y. Load-bearing properties of minimal-invasive monolithic lithium disilicate and zirconia occlusal onlays: finite element and theoretical analyses. Dent Mater. 2013;29(7):742–51.

9. Goujat A, Abouelleil H, Colon P, Jeannin C, Pradelle N, Seux D, Grosgogeat B. Marginal and internal fit of CAD-CAM inlay/onlay restorations: A systematic review of in vitro studies. J Prosthet Dent. 2019;121(4):590–7.

10. Wahied DM. Effect of Thickness and CAD/CAM Materials on the Fracture Resistance of Biomimetic Occlusal Veneers. MSA Dent J. 2024;3(2):11–20.

11. Yıldız P, Güneş Ünlü D, Aydoğdu HM. Evaluation of vertical marginal discrepancy and load-to-failure of monolithic zirconia and lithium disilicate laminate veneers manufactured in different thicknesses. BMC Oral Health. 2024;24(1):913.

12. Chaturvedi S, Alqahtani T, Alsolami S, Alqahtani A, Das G, Alsubaiy E. Fracture resistance of CAD-CAM all-ceramic surveyed crowns with different occlusal rest seat designs. J Adv Prosthodont. 2021;13(1):36.

13. Liu C, Eser A, Heintze S, Rothbrust F, Broeckmann C. Computation of the fracture probability and lifetime of all ceramic anterior crowns under cyclic loading–An FEA study. Dent Mater. 2023;39(11):965–76.

14. Arellano Moncayo AM, Peñate L, Arregui M, Giner-Tarrida L, Cedeño R. State of the art of different zirconia materials and their indications according to evidence-based clinical performance: A narrative review. Dent J. 2023;11(1):18.

15. Miyazaki T, Nakamura T, Matsumura H, Ban S, Kobayashi T. Current status of zirconia restoration. J Prosthodont Res. 2013;57(4):236–61.

16. Neto CF, Santos GC, Santos MJMC. Influence of the fabrication technique on the marginal and internal adaptation of ceramic onlays. Oper Dent. 2020;45(2):163–72.

17. Qian K, Yang X, Feng H, Liu Y. Marginal adaptation of different hybrid ceramic inlays after thermal cycling. Adv Appl Ceram. 2020;119(5–6):284–90.

18. Almohammed SN, Alshorman B, Abu-Naba'a LA. Mechanical properties of five esthetic ceramic materials used for monolithic restorations: A comparative in vitro study. Ceramics. 2023;6(2):1031–49.

19. Sivaraman K, Chopra A, Narayan AI, Balakrishnan D. Is zirconia a viable alternative to titanium for oral implant? A critical review. J Prosthodont Res. 2018;62(2):121–33.

20. Heydecke G, Butz F, Binder JR, Strub JR. Material characteristics of a novel shrinkage-free ZrSiO4 ceramic for the fabrication of posterior crowns. Dent Mater. 2007;23(7):785–91.

21. Almohammed SN, Dourado AM, Quran FAA. Fracture resistance and failure mode of monolithic zirconia, veneered zirconia, and metal-ceramic full-coverage restorations: A comparative in vitro study. Int J Prosthodont. 2024;37(1).

22. Tugwell P, Tovey D. PRISMA 2020. Journal of Clinical Epidemiology. 2021 Jun 1;134:A5-6.

23. Flemyng E, Moore TH, Boutron I, Higgins JP, Hróbjartsson A, Nejstgaard CH, Dwan K. Using Risk of Bias 2 to assess results from randomised controlled trials: guidance from Cochrane. BMJ Evidence-Based Medicine. 2023 Aug 1;28(4):260-6.

24. Whiting P, Savović J, Higgins JP, Caldwell DM, Reeves BC, Shea B, Davies P, Kleijnen J, Churchill R. ROBIS: a new tool to assess risk of bias in systematic reviews was developed. Journal of clinical epidemiology. 2016 Jan 1;69:225-34.

25. Shea BJ, Reeves BC, Wells G, Thuku M, Hamel C, Moran J, Moher D, Tugwell P, Welch V, Kristjansson E, Henry DA. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. bmj. 2017 Sep 21;358.

26. Stappert CF, Chitmongkolsuk S, Silva NR, Att W, Strub JR. Effect of mouth-motion fatigue and thermal cycling on the marginal accuracy of partial coverage restorations made of various dental materials. Dent Mater. 2008;24(9):1248–57.

27. Federlin M, Sipos C, Hiller KA, Thonemann B, Schmalz G. Partial ceramic crowns. Influence of preparation design and luting material on margin integrity—a scanning electron microscopic study. Clin Oral Investig. 2004;9(1):8–17.

28. Nassar H, Halim CH, Katamish HA. Clinical outcomes of zirconia-reinforced lithium silicate partial coverage crowns compared to lithium disilicate partial coverage crowns: A randomized controlled split-mouth clinical study. F1000Res. 2019;8:305.

29. Nawafleh N, Elshiyab S, Öchsner A, George R. In vitro fatigue and fracture load of monolithic ceramic crowns supported by hybrid abutment. Open Dent J. 2021;15(1).

30. Elmokadem MI, Haggag KM, Mohamed HR. Effect of thermo-mechanical cycling on fracture resistance of different CAD/CAM crowns: An in vitro study. J Contemp Dent Pract. 2024;25(1):29–34.

31. Foong JK, Judge RB, Palamara JE, Swain MV. Fracture resistance of titanium and zirconia abutments: An in vitro study. J Prosthet Dent. 2013;109(5):304–12.