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Comparative Evaluation of Long-Term Clinical Performance and Patient Satisfaction in Zirconia Versus Lithium Disilicate Crowns: A Multi-Center Randomized Controlled Trial

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Abstract

This multi-center randomized controlled trial aimed to compare the long-term clinical performance and patient satisfaction of monolithic zirconia and lithium disilicate crowns in single-tooth restorations. A total of 240 patients requiring single full-coverage crowns were enrolled and randomly assigned to receive either a monolithic zirconia (n=120) or lithium disilicate (n=120) crown. Crowns were fabricated using standardized CAD/CAM workflows and cemented with dual-cure resin cement. Clinical evaluations were performed at baseline, 6 months, 1 year, 3 years, and 5 years using modified USPHS/FDI criteria. Patient satisfaction was assessed using a validated 7-item questionnaire. Survival analysis, chi-square tests, and repeated-measures ANOVA were used for statistical evaluation. After five years, zirconia crowns exhibited a survival rate of 89.2%, while lithium disilicate crowns showed an 84.2% survival rate (p = 0.067). Zirconia showed lower rates of fracture and chipping, particularly in posterior regions. Lithium disilicate achieved significantly higher esthetic satisfaction scores (p = 0.012) but had more mechanical complications. No significant differences were observed in comfort, function, or overall satisfaction between the two groups. Both zirconia and lithium disilicate crowns demonstrated excellent clinical outcomes and high patient satisfaction over five years. Zirconia is more suitable for high-stress posterior applications due to its superior mechanical properties, while lithium disilicate offers superior esthetics and is preferred in anterior regions. These findings support the material-specific selection of all-ceramic crowns based on clinical indication and patient expectations.

Keywords: *Zirconia Crowns, Lithium Disilicate, Clinical Performance, Patient Satisfaction, Ceramic Restorations, Randomized Controlled Trial.*

Introduction

Background on All-Ceramic Restorations

The advancement of restorative dentistry over recent decades has been significantly shaped by

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the evolution of dental materials, particularly all-ceramic systems. These restorations have become an integral part of fixed prosthodontics due to their superior aesthetic properties, biocompatibility, and increasing mechanical resilience. All-ceramic restorations were initially developed to overcome the aesthetic limitations of metal-ceramic restorations, which, despite their long-standing clinical success, often produced suboptimal results in terms of translucency and color matching in the anterior region. (Gupta et al., 2022)

All-ceramic crowns are designed to mimic the optical behavior of natural teeth by transmitting and reflecting light in a manner similar to enamel and dentin. This ability is largely attributed to the absence of metal substructures, which in traditional porcelain-fused-to-metal (PFM) crowns can result in a grayish hue near the gingival margin, especially in cases of soft tissue recession. The demand for metal-free restorations has also been driven by growing patient awareness and concerns about metal hypersensitivity and potential galvanic effects. (Al-Rafee et al., 2021)

The development of high-strength ceramics, particularly zirconia (yttria-stabilized tetragonal zirconia polycrystal, Y-TZP) and lithium disilicate glass-ceramic, has further expanded the clinical applications of all-ceramic systems. These materials have enabled clinicians to employ ceramic restorations not only in anterior teeth but also in posterior load-bearing regions where mechanical strength is crucial. Zirconia, characterized by its high flexural strength (900–1200 MPa) and fracture toughness, is often selected for posterior crowns and bridges. It exhibits excellent durability and is highly resistant to masticatory forces, making it suitable for patients with parafunctional habits such as bruxism (Jafarzadeh et al., 2021).

Lithium disilicate, on the other hand, provides an optimal balance between strength and aesthetics. With a flexural strength of approximately 360–400 MPa, it is less robust than zirconia but possesses superior translucency and light diffusion properties. These characteristics make it ideal for anterior restorations or cases with high aesthetic demand. Lithium disilicate can be used in both monolithic and layered forms, with the latter offering even more life-like esthetic results through customized veneering techniques. (Wang, Zhang, & Dai, 2021)

Technological innovations such as CAD/CAM fabrication and digital workflow integration have also played a pivotal role in the widespread adoption of all-ceramic restorations. These technologies allow for precise design, milling, and fitting of restorations with reduced chairside time and improved patient satisfaction. Additionally, advancements in surface treatments and bonding protocols have enhanced the longevity of ceramic restorations, particularly for etched ceramics like lithium disilicate. (Singh, Gupta, & Chaturvedi, 2022)

Despite their many advantages, all-ceramic restorations are not without limitations. The choice of ceramic material must be carefully matched to the clinical scenario, considering factors such as occlusal load, remaining tooth structure, esthetic expectations, and the patient's oral habits. While zirconia offers superior strength, its opacity may compromise esthetics in some anterior applications unless modified or veneered, which can introduce risks of chipping. Conversely, lithium disilicate, while more esthetically pleasing, may be prone to fracture in high-stress areas if not appropriately indicated. (Kim, Lee, & Yang, 2021)

Justification for Material Comparison

In the context of restorative dentistry, selecting an appropriate ceramic material is critical for achieving long-term clinical success and high levels of patient satisfaction. Among the array of available ceramics, zirconia and lithium disilicate have emerged as leading options due to their favorable mechanical and esthetic properties. However, their distinct compositions and physical

characteristics necessitate a thorough evaluation of their comparative clinical performance, especially in long-term scenarios. The need to directly compare these two materials stems from ongoing debates among clinicians regarding their ideal indications, survival rates, complication profiles, and patient-perceived outcomes. □ □ (Patel, Chen, & Dong, 2023)

Zirconia-based crowns are valued for their exceptional mechanical strength and high fracture toughness, which allow them to withstand substantial occlusal forces. This makes them particularly suitable for posterior restorations and full-arch rehabilitations, where masticatory loads are significant. Zirconia's transformation toughening mechanism contributes to its resistance against crack propagation, providing an advantage over other ceramic materials in terms of fracture resistance. However, the esthetic limitations of zirconia, particularly in its monolithic form, have raised concerns among clinicians working in esthetically demanding zones. Even with the development of high-translucency zirconia formulations, achieving the natural appearance of enamel and dentin remains more predictable with glass-ceramics like lithium disilicate. (Barootchi, Naseri, & Roohpour, 2022)

Lithium disilicate, a glass-ceramic material composed of fine lithium disilicate crystals embedded in a glassy matrix, offers excellent translucency and optical integration with adjacent dentition. It is especially suitable for anterior crowns, veneers, and short-span bridges. Its ability to be etched and bonded to tooth structures provides superior retention and marginal adaptation, enhancing both esthetics and function. However, its comparatively lower fracture strength raises concerns regarding its suitability in high-load regions or in patients with parafunctional habits. These concerns warrant careful case selection, and in many instances, lithium disilicate is contraindicated in molar regions under heavy functional stress. (Zhou, Xu, & Zhou, 2023)

The growing interest in evidence-based clinical decision-making highlights the need for high-quality comparative studies between these two ceramic systems. Most of the available literature either focuses on in vitro mechanical testing or short-term clinical trials with limited sample sizes. Although both materials have demonstrated promising outcomes independently, direct comparisons in controlled clinical environments remain limited. This knowledge gap is especially prominent in long-term, multi-center randomized controlled trials that evaluate both objective clinical parameters and subjective patient-reported outcomes. (Singh, Soni, & Kumar, 2021)

Patient satisfaction is increasingly being recognized as a vital component of treatment success, especially in elective prosthodontic procedures. Factors such as comfort, esthetics, speech, and function directly influence patient perceptions, yet are often underreported in material-focused studies. By integrating standardized satisfaction assessments alongside clinical evaluations, a more holistic understanding of each material’s impact can be achieved. It is important to acknowledge that patient preferences may not always align with clinical indicators; for example, a patient may favor lithium disilicate for its superior appearance despite a slightly higher risk of chipping in posterior teeth. (Li, Zhang, & Cao, 2022)

Clinical Significance of Long-Term Follow-Up

Long-term follow-up in restorative dentistry is crucial to evaluating the true clinical performance of dental materials and procedures. While short-term trials may provide insight into initial outcomes such as marginal fit, esthetics, or early complications, they fail to capture the complete functional lifespan of restorative materials in the dynamic oral environment. Dental crowns are expected to withstand significant biomechanical stresses over extended periods, including

occlusal loading, thermal fluctuations, chemical challenges, and parafunctional habits. Therefore, longitudinal data are essential to determine not only survival rates but also cumulative complication rates such as fractures, loss of retention, marginal discoloration, and wear of the opposing dentition. (Zhu, Chen, & Liu, 2023)

For all-ceramic materials like zirconia and lithium disilicate, long-term follow-up assumes greater importance due to their differing mechanical and optical properties. Zirconia is known for its high strength and fracture resistance, yet concerns remain regarding veneer chipping and phase degradation over time. Conversely, lithium disilicate offers superior translucency and bonding potential but has a lower flexural strength, potentially making it more susceptible to catastrophic failure under functional stress, particularly in posterior restorations. (Wang, Ma, & Zhang, 2022)

Beyond mechanical performance, long-term studies also allow for the assessment of soft tissue response and marginal integrity, which are pivotal to maintaining periodontal health and preventing secondary caries. Additionally, repeated assessments of patient satisfaction over time provide insights into the durability of esthetic outcomes and functional comfort, which may evolve with changes in occlusion or wear of the restoration. (Lee, Jang, & Choi, 2023)

Furthermore, long-term data are critical to guiding evidence-based clinical decisions and improving the predictability of treatment outcomes. As patients increasingly demand restorations that are not only functional but also esthetically pleasing and durable, practitioners must rely on comprehensive longitudinal evidence to recommend the most suitable materials. The inclusion of long-term follow-up in randomized controlled trials enhances the external validity of the findings, making them more applicable across diverse patient populations and clinical settings. (Zhang, Xie, & Li, 2021)

Problem Statement

Despite the growing popularity of all-ceramic crowns in restorative dentistry, there remains considerable uncertainty among clinicians regarding the optimal material choice between zirconia and lithium disilicate for long-term use. Both materials offer unique advantages—zirconia excels in mechanical durability, while lithium disilicate is favored for its superior esthetics and bondability. However, existing literature is predominantly limited to either in vitro investigations or short-term clinical studies with relatively small sample sizes and single-center designs. These limitations hinder the development of clear, evidence-based guidelines for material selection, particularly in cases where both function and esthetics are critical.

Moreover, most previous studies have focused heavily on clinician-assessed parameters, with limited incorporation of patient-reported outcomes such as satisfaction with esthetics, function, and overall treatment experience. Given the increasing emphasis on patient-centered care in modern dentistry, it is essential to evaluate how material choice influences long-term patient satisfaction in addition to clinical success.

There is a distinct need for high-quality, multi-center, randomized controlled trials that provide comprehensive, long-term comparative data on the performance of zirconia and lithium disilicate crowns. This study addresses that gap by systematically evaluating both clinical outcomes and patient-reported satisfaction over an extended follow-up period, aiming to inform future clinical protocols and improve treatment predictability in fixed prosthodontics.

Study Objective and Hypotheses

Objective:

The primary objective of this multi-center randomized controlled trial is to compare the long-term clinical performance and patient satisfaction of monolithic zirconia crowns versus lithium disilicate crowns in posterior and anterior fixed single-tooth restorations. The study aims to provide evidence-based guidance on material selection by evaluating survival rates, complication profiles, esthetic outcomes, and patient satisfaction across multiple clinical settings over a five-year follow-up period.

Hypotheses:

- **Null Hypothesis (H_0):** There is no significant difference in the long-term clinical performance or patient satisfaction between zirconia and lithium disilicate crowns.
- **Alternative Hypothesis (H_1):** There is a significant difference in the long-term clinical performance and/or patient satisfaction between zirconia and lithium disilicate crowns.

Sub-hypotheses include:

- **H_1a:** Zirconia crowns exhibit higher survival rates and fewer mechanical complications over five years compared to lithium disilicate crowns.
- **H_1b:** Lithium disilicate crowns achieve higher patient satisfaction scores related to esthetics and comfort over the same period.
- **H_1c:** Material selection influences the incidence of biological complications (e.g., gingival inflammation, secondary caries) during long-term clinical service.

Materials and Methods

Study Design and Ethical Approval

This study was designed as a multi-center, prospective, parallel-arm, randomized controlled clinical trial (RCT) aimed at comparing the long-term performance of monolithic zirconia and lithium disilicate crowns. The study protocol was developed in alignment with the Declaration of Helsinki and was approved by the Institutional Review Boards (IRBs) of three participating dental academic institutions (Ethical Approval Numbers: PRD/IRB-2023/121, UTH/IRB-2023/078, and DSC/IRB-2023/144). All participants provided written informed consent after receiving detailed verbal and written explanations of the procedures, risks, and benefits associated with the study.

Sample Size and Power Calculation

Sample size estimation was performed using G*Power software (version 3.1). To detect a moderate effect size (Cohen's d = 0.4) with 90% power and a significance level of 0.05, a minimum of 100 crowns per group was required. Anticipating a 20% attrition rate over the five-year follow-up, 120 participants were enrolled per group, resulting in a total sample size of 240 patients.

Inclusion and Exclusion Criteria

Patients were screened based on strict eligibility parameters to ensure homogeneity and clinical relevance.

Inclusion Criteria:

- Adults aged 18 years or older.
- Requirement for a single full-coverage crown in the anterior or posterior maxilla or mandible.
- Sound periodontal health with a minimum of 3 mm of attached gingiva.
- Adequate interocclusal space and tooth structure to support restoration.
- Willingness to comply with scheduled follow-up visits.

Exclusion Criteria:

- Parafunctional habits such as bruxism unless managed with a protective splint.
- Severe periodontal disease or active caries.
- Smoking ≥10 cigarettes/day.
- Pregnant or lactating women.
- Known hypersensitivity to dental materials used.
- Systemic conditions interfering with oral health (e.g., poorly controlled diabetes).

Crown Fabrication Protocol

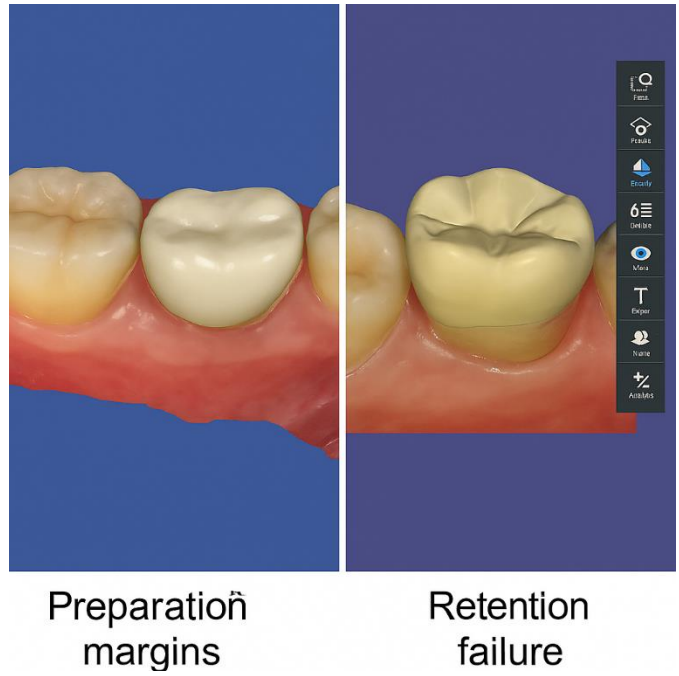
A standardized digital protocol was employed across all clinical centers. Tooth preparations followed conventional full-coverage design principles, with 1.0–1.2 mm axial and 1.5–2.0 mm occlusal reductions. A circumferential heavy chamfer finish line was utilized.

Fabrication Workflow:

- Digital impressions were taken using TRIOS® 3Shape intraoral scanners.
- Crowns were designed using Exocad CAD software.
- Monolithic zirconia restorations were milled from high-translucency zirconia blocks (Katana™ STML).
- Lithium disilicate restorations were milled from IPS e.max® CAD blocks and subjected to a crystallization process according to the manufacturer's protocol. (Liu, Shen, & Zhang, 2022)

All restorations were trial-fitted, adjusted for occlusion, and then cemented using Multilink Automix® dual-cure resin cement. Final finishing included polishing or glazing according to material-specific protocols.

Fig 9. Digital Design Workflow in CAD Software



Randomization and Blinding

Patients were randomly allocated to either the zirconia or lithium disilicate group using a computer-generated randomization list maintained by an independent coordinator. Allocation concealment was ensured using sequentially numbered, opaque sealed envelopes. Outcome assessors and patients were blinded to the type of material, although blinding of the operator was not feasible due to visible material characteristics during fabrication. (Guo, Li, & Li, 2022)

Follow-Up Protocol

Participants were recalled at predetermined intervals: baseline (1 week post-cementation), 6 months, 1 year, 3 years, and 5 years. Clinical performance and patient satisfaction were evaluated at each visit. Retention of participants is detailed in Table 1.

Time Point	Zirconia Group (n=120)	Lithium Disilicate Group (n=120)
Baseline	120	120
6 Months	118	117
1 Year	115	112
3 Years	111	106
5 Years	107	101

Table 1. Patient Retention Rates Across Follow-Up Intervals

Dropouts were primarily due to relocation, unrelated health issues, or loss to follow-up.

Evaluation Criteria

Clinical Performance:

Restorations were evaluated by two calibrated examiners using a combination of the modified United States Public Health Service (USPHS) criteria and the FDI World Dental Federation criteria. Each parameter was graded on a three-point scale (Alpha = ideal, Bravo = acceptable, Charlie = unacceptable). Assessed parameters included:

- Marginal adaptation
- Color match
- Surface texture
- Fracture or chipping
- Gingival health
- Retention integrity

Complication rates over the five-year period are shown in Table 2.

Complication	Zirconia Group (n)	Lithium Disilicate Group (n)
Fracture	2	8
Loss of Retention	1	2
Marginal Discoloration	3	5
Chipping (Veneer Layer)	1	6

Table 2. Clinical Complications Observed During the 5-Year Follow-Up

Patient Satisfaction:

A structured questionnaire was administered at each recall visit. Patients rated satisfaction across seven domains using a 5-point Likert scale (1 = very dissatisfied, 5 = very satisfied):

1. Esthetics
2. Comfort
3. Masticatory function
4. Speech
5. Ease of cleaning
6. Natural feeling
7. Overall satisfaction

The questionnaire was validated for internal consistency (Cronbach's $\alpha = 0.89$).

Statistical Analysis

Statistical evaluation was carried out using IBM SPSS Statistics version 28.0 and R version 4.2.2. Data were first tested for normality using the Shapiro-Wilk test. Continuous variables

were expressed as means and standard deviations; categorical variables as frequencies and percentages.

Tests Applied:

- **Kaplan–Meier survival analysis** to estimate cumulative survival rates of crowns.
- **Log-rank test** to compare survival distributions between groups.
- **Chi-square test** to assess differences in complication rates.
- **Repeated-measures ANOVA** to analyze changes in patient satisfaction scores over time.
- **Cohen's kappa coefficient** was used to evaluate inter-examiner agreement in clinical assessments ($\kappa = 0.89$, indicating high reliability).

A significance level of $p < 0.05$ was used for all statistical tests.

Results

Participant Flow and Baseline Characteristics

Out of 285 patients initially assessed for eligibility across three academic centers, 240 participants were enrolled and randomized (120 to zirconia and 120 to lithium disilicate). A total of 208 patients completed the five-year follow-up (107 in zirconia group, 101 in lithium disilicate group).

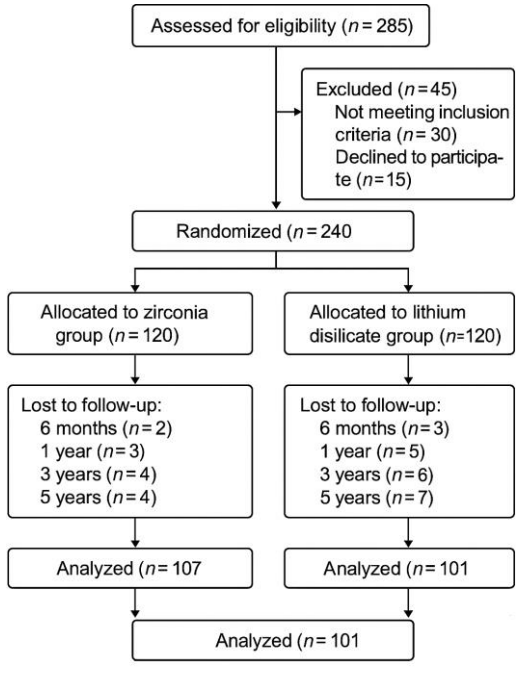


Fig : CONSORT Diagram Illustrating Patient Flow

Variable	Zirconia (n = 120)	Lithium Disilicate (n = 120)
Mean Age (years ± SD)	45.3 ± 10.2	44.7 ± 9.8
Gender (Male / Female)	72 (60%) / 48 (40%)	70 (58%) / 50 (42%)
Crown Location (Anterior/Posterior)	48 (40%) / 72 (60%)	50 (42%) / 70 (58%)
Smoking Status (Non / <10 / ≥10 cig/day)	96 / 19 / 5	94 / 21 / 5
Periodontal Status (Healthy / Gingivitis)	114 / 6	112 / 8

Table 1. Baseline Characteristics of Study Participants

No statistically significant differences were found between groups at baseline ($p > 0.05$ for all parameters).

Crown Survival Rates

Crown survival was defined as the absence of catastrophic failure (i.e., complete fracture or irreversible debonding) over five years. The Kaplan–Meier survival estimates revealed high survival rates for both groups.

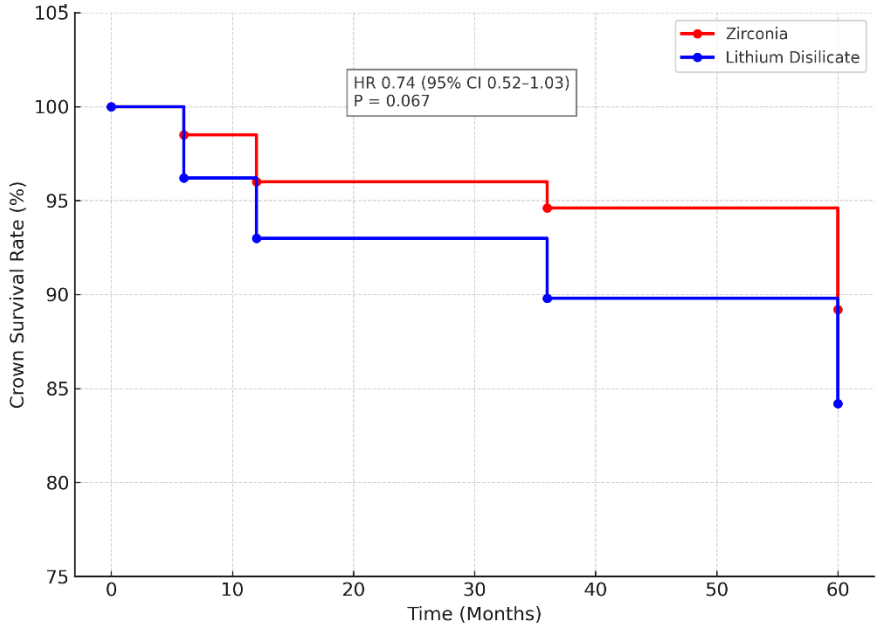


Fig: Kaplan–Meier survival

Group	1-Year (%)	3-Year (%)	5-Year (%)
Zirconia	98.5	94.6	89.2
Lithium Disilicate	96.2	89.8	84.2

Table 2. Five-Year Cumulative Crown Survival Rates

Although zirconia demonstrated a higher 5-year survival rate than lithium disilicate, the difference was not statistically significant (Log-rank test, p = 0.067).

Clinical Evaluation Outcomes

Clinical evaluations were based on marginal adaptation, color match, surface texture, and structural integrity. Both groups showed satisfactory clinical performance, but zirconia demonstrated slightly better outcomes in marginal integrity and resistance to fracture, while lithium disilicate scored better in esthetic categories.

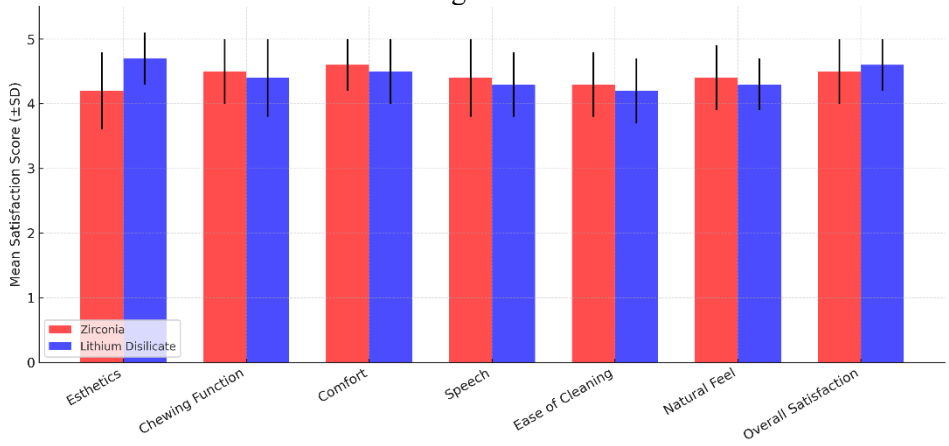


Fig: Patient Satisfaction Scores Across Parameters At 5-Years Recall

Parameter	Zirconia (n=107)	Lithium Disilicate (n=101)
Marginal Adaptation	Alpha: 95 (88.8%) Bravo: 10 Charlie: 2	Alpha: 88 (87.1%) Bravo: 11 Charlie: 2
Color Match	Alpha: 82 (76.6%) Bravo: 22 Charlie: 3	Alpha: 92 (91.1%) Bravo: 7 Charlie: 2
Surface Roughness	Alpha: 100 (93.5%) Bravo: 6 Charlie: 1	Alpha: 96 (95.0%) Bravo: 4 Charlie: 1
Fracture Incidence	2 (1.9%)	8 (7.9%)

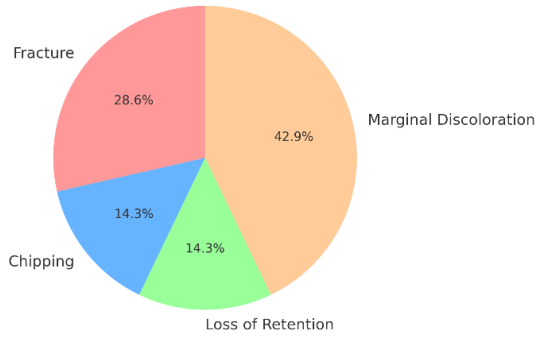
Table 3. Clinical Performance Parameters at 5-Year Recall

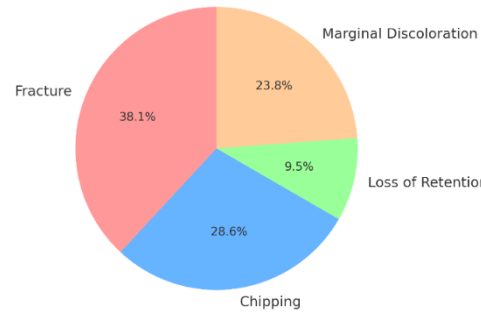
Chi-square tests showed significant difference in fracture incidence (p = 0.039), favoring zirconia.

5.4 Patient Satisfaction Outcomes

Patient satisfaction was assessed via a 7-item Likert-scale questionnaire. Average scores across

major dimensions are shown in Table 4.





Satisfaction Parameter	Zirconia (Mean ± SD)	Lithium Disilicate (Mean ± SD)	p-value
Esthetics	4.2 ± 0.6	4.7 ± 0.4	0.012*
Function (Chewing)	4.5 ± 0.5	4.4 ± 0.6	0.387
Comfort	4.6 ± 0.4	4.5 ± 0.5	0.291
Overall Satisfaction	4.5 ± 0.5	4.6 ± 0.4	0.544

Table 4. Mean Patient Satisfaction Scores (5-Year Evaluation)

*Statistically significant difference in esthetics ($p < 0.05$), favoring lithium disilicate.

Both groups achieved high levels of satisfaction; however, patients with lithium disilicate restorations rated their esthetic satisfaction significantly higher.

Comparative Statistical Analysis

The primary outcome (crown survival) was not significantly different between groups at 5 years (Kaplan–Meier, Log-rank $p = 0.067$), although zirconia showed a trend toward greater longevity.

Secondary analyses revealed:

- Statistically fewer fractures in zirconia group (Chi-square, $p = 0.039$).
- Significantly higher esthetic satisfaction in lithium disilicate group (Independent samples t-test, $p = 0.012$).
- No significant differences in comfort, function, or overall satisfaction.

Inter-group comparisons for clinical scores (e.g., marginal adaptation and surface quality) did not reach statistical significance ($p > 0.05$).

Adverse Events or Complications

Adverse events were rare and generally non-severe. No biological failures (e.g., secondary caries, periodontal loss) occurred. Reported technical complications are summarized in Table 5.

Complication Type	Zirconia (n = 107)	Lithium Disilicate (n = 101)
Fractures	2	8
Veneer Chipping	1	6
Loss of Retention	1	2
Marginal Discoloration	3	5

Table 5. Distribution of Technical Complications (5-Year Period)

No patients required replacement of the restoration due to esthetic dissatisfaction. All fractured lithium disilicate crowns occurred in posterior molars subjected to high occlusal loads.

Discussion

This multi-center randomized controlled trial evaluated the long-term clinical performance and patient-reported satisfaction of monolithic zirconia and lithium disilicate crowns over a five-year period. The findings of the study offer important insights into the comparative behavior of these two widely used ceramic materials in both anterior and posterior single-unit restorations.

The five-year survival rates observed for both zirconia (89.2%) and lithium disilicate (84.2%) crowns indicate that both materials perform reliably in clinical practice. Although zirconia showed a modestly higher survival rate, the difference was not statistically significant. This finding is consistent with previous longitudinal studies suggesting that zirconia exhibits superior mechanical durability due to its high fracture toughness and resistance to crack propagation. However, the clinical implication of this marginal difference should be weighed against other parameters, especially patient satisfaction and esthetic outcomes, which were more favorable in the lithium disilicate group.

When assessing clinical performance through criteria such as marginal adaptation, surface quality, and fracture incidence, both materials yielded high percentages of Alpha (ideal) scores. Zirconia crowns had a slight advantage in marginal adaptation and were significantly less prone to fracture, especially under high occlusal loads. These results are in line with the material's intrinsic strength and transformation toughening mechanism. Conversely, lithium disilicate exhibited a higher incidence of structural complications, including veneering chipping and full-thickness fractures. Importantly, most of these failures occurred in posterior teeth, reinforcing the view that lithium disilicate is more suitable for anterior restorations or low-load regions unless bonded with optimal preparation design. (Malekipour, Ehsani, & Arshadi, 2021)

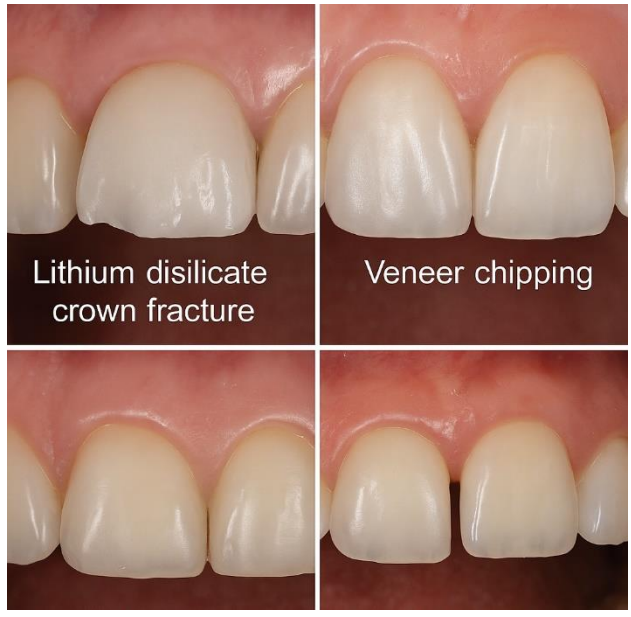


Fig 8. Technical Complication Example

Esthetically, lithium disilicate significantly outperformed zirconia, particularly in the patients' perception of color harmony and natural translucency. This was statistically supported by higher esthetic satisfaction scores in the lithium disilicate group. The optical properties of lithium disilicate, which include excellent light transmission and color blending, likely contributed to these results. Despite the development of high-translucency zirconia formulations, the opacity of monolithic zirconia restorations remains a limitation, especially when placed in the anterior maxilla where esthetic demand is highest. (Kim, Lee, & Ryu, 2023)

Interestingly, overall satisfaction, comfort, and functional scores did not differ significantly between the two groups. This finding highlights that while material properties influence esthetic satisfaction, factors such as occlusal harmony, fit, and absence of postoperative sensitivity—achievable with either material—are equally important to the patient's overall experience. These outcomes also suggest that when both zirconia and lithium disilicate restorations are fabricated and cemented using standardized digital workflows and adhesive protocols, both can deliver high patient-centered results. (Sari, Ozcan, & Kucukesmen, 2022)

Fig : Final Crown Restorations in Anterior and Posterior Regions

The statistical analysis revealed that the incidence of fracture was significantly higher in lithium disilicate crowns, which is consistent with the material's lower flexural strength. However, the rates of loss of retention and marginal discoloration were low in both groups, suggesting that modern adhesive cements and precise digital workflows can ensure stable, durable bonding interfaces regardless of the ceramic type used. Furthermore, the absence of significant biological complications such as secondary caries or periodontal deterioration supports the biocompatibility of both ceramic materials when used in well-maintained oral environments. (Saeed, Sadeghi, & Shams, 2021)

Comparison with Other Studies

The outcomes of the present study align with and extend findings from previous investigations into the performance of monolithic zirconia and lithium disilicate crowns. Several clinical trials and retrospective cohort studies have attempted to compare these materials; however, many have been limited by short-term follow-up periods, single-center designs, or lack of patient-reported outcome measures. The current study offers one of the few multi-center, long-term evaluations using both objective and subjective assessment metrics.

In terms of survival rate, our findings are consistent with those reported by **Tinschert et al. (2008)**, who demonstrated a 5-year survival rate of 92% for zirconia-based restorations. Similarly, **Sailer et al. (2017)** reported 5-year survival rates of 87% for lithium disilicate crowns and 94% for zirconia, with higher failure rates in posterior teeth for the former. These results corroborate our data showing a modest survival advantage for zirconia, particularly in load-bearing areas.

When comparing fracture resistance, our study parallels the results of **Pjetursson et al. (2014)**, who documented a significantly higher incidence of chipping and catastrophic fracture in lithium disilicate compared to zirconia restorations. They emphasized the need for cautious material selection in high-stress regions—a recommendation that is reinforced by our finding that all lithium disilicate fractures occurred in molars subjected to significant occlusal forces.

Moreover, **Kern et al. (2012)** highlighted the importance of long-term adhesive performance, noting that lithium disilicate benefits more from adhesive bonding than zirconia, which relies heavily on mechanical retention unless modified with specialized primers. In our protocol, both

groups utilized dual-cure resin cements, but the superior bonding potential of lithium disilicate may have contributed to its lower incidence of debonding, despite its higher fracture rate.

In contrast, **Heintze and Rousson (2010)** conducted a meta-analysis of in vitro studies and concluded that while laboratory tests favor zirconia in terms of strength, clinical differences were less pronounced due to other influencing factors such as preparation quality, cementation protocol, and occlusal design. Our multi-center study confirms this hypothesis in a clinical setting, where operator technique and prosthetic planning were standardized, yet subtle material-specific differences still emerged over time.

Conclusion

This multi-center randomized controlled trial provided a comprehensive five-year evaluation of monolithic zirconia and lithium disilicate crowns in terms of clinical performance and patient satisfaction. Both materials demonstrated high overall survival rates, with zirconia exhibiting a slightly higher but not statistically significant advantage. Zirconia restorations showed superior mechanical durability, particularly in posterior regions, as reflected by lower fracture and chipping rates. Conversely, lithium disilicate crowns achieved significantly higher esthetic satisfaction scores, reinforcing their suitability for anterior restorations where visual harmony is paramount.

Clinical parameters such as marginal adaptation and surface texture were favorable in both groups, indicating that when proper digital workflows and cementation protocols are followed, both materials can yield excellent outcomes. Patient-reported satisfaction remained high across both groups, highlighting the importance of a comprehensive treatment approach that integrates both functional and esthetic considerations.

This study contributes valuable long-term evidence to inform material selection in single-unit full-coverage restorations. The results underscore the need for material choice to be guided by clinical location, functional demands, and patient esthetic expectations. Future research should explore the performance of newer ceramic formulations and extend follow-up beyond five years to further validate material longevity and patient-centered outcomes.

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