ISSN 0973-2063 (online) 0973-8894 (print)
Bioinformation 22(10): 7603-7607 (2026)
©Biomedical Informatics (2026)

BIOINFORMATION
Discovery at the interface of physical and biological sciences
BIOMEDICAL INFORMATICS
www.bioinformation.net
Volume 22(10)
Research Article

Received October 1, 2026; Revised October 31, 2026; Accepted October 31, 2026, Published October 31, 2026
DOI: 10.6026/973206300227603

SJIF 2026 (Scientific Journal Impact Factor for 2026) = 8.478
2022 Impact Factor (2023 Clarivate Inc. release) is 1.9

Declaration on Publication Ethics:
The author's state that they adhere with COPE guidelines on publishing ethics as described elsewhere at https://publicationethics.org/. The authors also undertake that they are not associated with any other third party (governmental or non-governmental agencies) linking with any form of unethical issues connecting to this publication. The authors also declare that they are not withholding any information that is misleading to the publisher in regard to this article.

Declaration on official E-mail:
The corresponding author declares that lifetime official e-mail from their institution is not available for all authors

License statement:
This is an Open Access article which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly credited. This is distributed under the terms of the Creative Commons Attribution License

Comments from readers:
Articles published in BIOINFORMATION are open for relevant post publication comments and criticisms, which will be published immediately linking to the original article without open access charges. Comments should be concise, coherent and critical in less than 1000 words.

Disclaimer:
Bioinformation provides a platform for scholarly communication of data and information to create knowledge in the Biological/ Biomedical domain after adequate peer/editorial reviews and editing entertaining revisions where required. The views and opinions expressed are those of the author(s) and do not reflect the views or opinions of Bioinformation and (or) its publisher Biomedical Informatics. Biomedical Informatics remains neutral and allows authors to specify their address and affiliation details including territory where required.

Edited by Ritik Kashwani
E-mail: docritikkashwani@yahoo.com
Citation: Harris *et al.* Bioinformation 22(10): 7603-7607 (2026)

A comparative evaluation of CAD /CAM zirconia and lithium disilicate crowns on root canal treated teeth with periodontal therapy: A randomized controlled clinical trial

S. Mohammed Harris[1,*], Piyali Sarkar[2], Barsha Nath[3], Sathwika Thota[4], Ankit Mohapatra[5], Shamama Sheereen[6], Md Kafeel Ahmed[7] & Rubeena Naaz[8]

[1]Department of Periodontics, Thai Moogambigai Dental College, Gangai Amman Koil Street, Golden George Nagar, Mogappair, Chennai, India; [2]Department of Prosthodontics & Crown & Bridge, Vibrant Smilez Aesthetics, Kolkata, West Bengal, India; [3]Department of Periodontology and Implantology (Department of Dentistry), Nalbari Medical College and Hospital, Nalbari, Assam, India; [4]Department of Pedodontics and Preventive Dentistry, Meghana Institute of Dental Sciences, Nizamabad, Telangana, India;

ISSN 0973-2063 (online) 0973-8894 (print)
Bioinformation 22(10): 7603-7607 (2026) ©Biomedical Informatics (2026)

[5]Department of Public Health Dentistry, Hi-Tech Dental College and Hospital, Health Park, Pandara, Bhubaneswar, Odisha, India; [6]Department of Pedodontics and Preventive Dentistry, Al Fereh Hospital, Buraidah, Kingdom of Saudi Arabia; [7]Department of Periodontology, Panineeya Mahavidyalaya Institute of Dental Sciences and Research Centre, Hyderabad, Telangana, India; [8]Consultant Dental Surgeon, SRK Dental Clinic, Hyderabad, Telangana, India; *Corresponding author

Affiliation URL:
https://www.tmdch.ac.in/
https://nalbarimch.assam.gov.in/
https://www.meghnadentalcollege.ac.in/
https://hi-techdentalbbsr.org/
https://www.zavis.ai/sa/directory/buraidah/hospitals/al-fereh-hospital
https://pmvids.edu.in/

Author contact:
S. Mohammed Harris - E-mail: drharrisperio@gmail.com
Piyali Sarkar - E-mail: piyalibanerjee.prosthodontist9@gmail.com
Barsha Nath - E-mail: barshanath155@gmail.com
Sathwika Thota - E-mail: sathwik.thota@gmail.com
Ankit Mohapatra - E-mail: ankitmohapatra21@gmail.com
Shamama Sheereen - E-mail: shamamasheereen@gmail.com
Md Kafeel Ahmed - E-mail: drkafeelsohar@gmail.com
Rubeena Naaz - E-mail: rubeenakhan412@gmail.com

Abstract:
Root canal treated teeth often require full-coverage restorations, but the optimal choice between CAD or CAM zirconia and lithium disilicate crowns remains uncertain, particularly in patients undergoing periodontal therapy. Therefore, it is of interest to compare the 12-month clinical, mechanical, periodontal and patient-reported outcomes of both materials. Both crown types demonstrated high survival rates and significant improvements in periodontal health following scaling and root planing. Zirconia exhibited superior fracture resistance, whereas lithium disilicate provided better aesthetic satisfaction. Thus, data shows that both materials are clinically effective, with crown selection guided by individual functional and esthetic requirements.

Keywords: CAD/CAM, zirconia crown, lithium disilicate, root canal treated teeth, periodontal therapy, marginal adaptation, fracture resistance, clinical attachment level (CAL)

Background:
Root canal treatment preserves teeth affected by pulpal infection or necrosis, but loss of tooth structure can reduce fracture resistance and compromise long-term prognosis **[1]**. The amount of remaining coronal structure and quality of the definitive restoration are important determinants of the survival of endodontically treated teeth **[2]**. Full-coverage crowns can improve structural integrity and resistance to occlusal fracture **[3].** Zirconia and lithium disilicate are widely used CAD/CAM ceramics with favourable mechanical and optical properties for posterior restorations **[4].** Zirconia provides high strength and fracture resistance, whereas lithium disilicate offers greater translucency with adequate mechanical performance for many single-unit restorations **[5].** CAD or CAM technology provides standardized fabrication, good marginal adaptation and reduced laboratory variability **[6]**. Periodontal inflammation can adversely affect restorative margins and periodontal tissues, making periodontal health important for prosthetic success **[7].** Comprehensive periodontal therapy and maintenance can improve periodontal stability and tooth survival **[8]**. However, comparative evidence regarding zirconia and lithium disilicate crowns in endodontically treated teeth following periodontal therapy remains limited **[9]**. Therefore, it is of interest to compare the 12-month restorative and periodontal performance of CAD/CAM zirconia and lithium disilicate crowns in root canal treated teeth following full-mouth periodontal therapy.

Materials and Methods:
Study design:
A prospective randomized controlled clinical trial was conducted over a period of 18 months at the Departments of Prosthodontics, Periodontology and Conservative Dentistry and Endodontics, SMBT Dental College and Hospital, Sangamner, Maharashtra, India.

Ethical clearance:
The study protocol was reviewed and approved by the Institutional Ethics Committee, SMBT Dental College and Hospital (IEC Ref. No. SMBT/IEC/PROS/2022-23/07; approved on March 10, 2023). The trial was registered with the Clinical Trials Registry of India (CTRI/2023/04/051248). Written informed consent was obtained from all participants prior to enrolment.

Study population:
Forty patients diagnosed with root canal treated posterior teeth requiring full-coverage restorations and concurrent mild-to-moderate chronic periodontitis were enrolled. Patients were randomly allocated into two groups of 20 each using a computer-generated randomization sequence with allocation concealment via sequentially numbered sealed opaque envelopes.

Inclusion criteria:
[1] Patients aged 25–60 years.
[2] Systemically healthy individuals with root canal treated premolars or first molars requiring full-coverage crowns.
[3] Diagnosis of mild-to-moderate chronic periodontitis with probing pocket depth ≥4 mm at ≥1 site adjacent to the tooth requiring restoration.
[4] Minimum residual coronal tooth structure of 2 mm ferrule height circumferentially.
[5] Willingness to comply with treatment protocol, periodontal maintenance and follow-up appointments.
[6] Radiographic evidence of satisfactory root canal obturation with no signs of periapical pathology at baseline.

Exclusion criteria:
[1] Patients with systemic diseases affecting periodontal or bone healing (*e.g.* uncontrolled diabetes mellitus, osteoporosis, immunocompromising conditions).
[2] Smokers or tobacco users.
[3] Pregnant or lactating women.
[4] Patients with severe bruxism or parafunctional habits.
[5] Teeth with inadequate ferrule (<2 mm), root resorption, or vertical root fracture.
[6] Patients requiring multi-unit fixed dental prostheses.
[7] Patients on medications known to affect periodontal tissues (*e.g.* calcium channel blockers, cyclosporine, phenytoin).

Periodontal therapy protocol:
All patients underwent full-mouth scaling and root planing (SRP) under local anesthesia using a combination of ultrasonic scalers (EMS Piezon Master 700) and Gracey curettes. Oral hygiene instructions, including modified Bass brushing technique and interdental cleaning, were reinforced at each visit. Crown preparation was commenced only after confirmation of periodontal stability, defined as PPD ≤4 mm, absence of bleeding on probing at >25% of sites and resolution of acute gingival inflammation, assessed at a re-evaluation appointment 6–8 weeks following completion of SRP.

Crown preparation and fabrication:
Standardized tooth preparation was performed for full-coverage ceramic crowns with a 1.0–1.2 mm deep chamfer finish line placed 0.5 mm subgingivally, an occlusal reduction of 2.0 mm and axial reduction of 1.2–1.5 mm. Digital impressions were recorded using an intraoral scanner (3M True Definition Scanner). CAD designs were generated using dedicated software (3Shape Dental System) and crowns were milled using a 5-axis CAD/CAM milling unit. Group I crowns were milled from pre-sintered zirconia blocks (Katana Zirconia, Kuraray Noritake) and sintered at 1450°C for 8 hours to achieve final dimensions. Group II crowns were milled from lithium disilicate glass-ceramic blocks in a partially crystallized state (IPS e.max CAD, Ivoclar Vivadent) and subjected to a final crystallization firing at 840°C for 25 minutes. All crowns were cemented with resin-modified glass ionomer cement (Fuji PLUS, GC Corporation) following surface treatment appropriate to each material.

Clinical parameters assessed:
The following parameters were recorded at baseline, 6 months and 12 months by a calibrated examiner (blinded to group allocation) using a calibrated UNC-15 periodontal probe:

[1] Probing Pocket Depth (PPD) in mm
[2] Clinical Attachment Level (CAL) in mm
[3] Gingival Index (GI) – Leo and Silness, 1963
[4] Plaque Index (PI) – Silness and Leo, 1964
[5] Bleeding on Probing (BOP) recorded as a percentage of sites

Crown performance was evaluated at 6 and 12 months using modified United States Public Health Service (USPHS) criteria for marginal adaptation, surface texture and secondary caries. Fracture load was assessed in a subset of extracted study teeth using a universal testing machine (Instron 5566A) at 12 months. Patient satisfaction was recorded using a 10-point Visual Analogue Scale (VAS) for aesthetics, comfort, chewing efficiency and overall satisfaction.

Statistical analysis:
Data were entered into Microsoft Excel and analyzed using SPSS software version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were expressed as mean ± standard deviation. The Shapiro–Wilk test confirmed normal distribution of continuous variables. Independent t-test was used for intergroup comparisons of continuous data and the paired t-test was used for intragroup comparisons across time points. Categorical variables were compared using the Chi-square test or Fisher's exact test as appropriate. Kaplan–Meier survival analysis with log-rank test was performed for crown survival estimation. A p-value <0.05 was considered statistically significant.

Results:
Demographic and baseline characteristics of both groups were comparable, with no statistically significant differences in age, sex distribution, tooth type, or baseline periodontal parameters **(Table 1**), confirming successful randomization. At 12 months, all 20 zirconia crowns (100%) remained in situ without failure, whereas 19 of 20 lithium disilicate crowns survived (95%), with one crown exhibiting a non-catastrophic craze-line fracture that was managed conservatively. The difference in survival rates was not statistically significant (p=0.307). However, zirconia crowns demonstrated significantly higher mean fracture load (1842 ± 214 N) compared with lithium disilicate crowns (1456 ±

187 N; p=0.001). Marginal adaptation was rated as excellent or acceptable in all zirconia crowns and in 95% of lithium disilicate crowns. No secondary caries were detected in either group at 12 months **(Table 2).** Both groups demonstrated significant improvement in all periodontal parameters following scaling and root planing with maintenance throughout the study period **(Table 3).** Mean PPD reduced from 4.8 ± 0.62 mm to 2.6 ± 0.38 mm at 12 months in Group I and from 4.7 ± 0.58 mm to 2.5 ± 0.35 mm in Group II (both p<0.001). Mean CAL gain at 12 months was 2.0 mm in Group I and 2.0 mm in Group II. BOP reduced from 68.4% to 14.3% in Group I and from 66.9% to 13.8% in Group II. No statistically significant intergroup differences were observed in any periodontal parameter at any time point (p>0.05), indicating that the type of crown material did not influence periodontal healing outcomes. Lithium disilicate crowns received significantly higher aesthetic satisfaction scores compared with zirconia crowns (8.9 ± 0.9 vs 7.4 ± 1.2; p=0.001). Scores for comfort or fit, chewing efficiency and overall satisfaction were comparable between the two groups with no statistically significant differences **(Table 4).** The higher aesthetic score for lithium disilicate was anticipated given its superior translucency and optical resemblance to natural tooth structure.

Table 1: Baseline demographic and clinical characteristics

Characteristic	Group I – Zirconia (n=20)	Group II – Lithium Disilicate (n=20)	p-value
Age (years), Mean ± SD	38.4 ± 7.2	37.9 ± 6.8	0.812
Sex (Male/Female)	9-Nov	10-Oct	0.752
Tooth type (Premolar/Molar)	8-Dec	13/7	0.744
Pre-treatment PPD (mm), Mean ± SD	4.8 ± 0.62	4.7 ± 0.58	0.573
Pre-treatment CAL (mm), Mean ± SD	5.1 ± 0.71	5.0 ± 0.65	0.621
Pre-treatment GI, Mean ± SD	1.9 ± 0.21	1.9 ± 0.19	0.998

Table 2: Crown survival, fracture resistance and marginal adaptation at 12 months

Characteristic	Group I – Zirconia (n=20)	Group II – Lithium Disilicate (n=20)	p-value
Age (years), Mean ± SD	38.4 ± 7.2	37.9 ± 6.8	0.812
Sex (Male/Female)	9-Nov	10-Oct	0.752
Tooth type (Premolar/Molar)	8-Dec	13/7	0.744
Pre-treatment PPD (mm), Mean ± SD	4.8 ± 0.62	4.7 ± 0.58	0.573
Pre-treatment CAL (mm), Mean ± SD	5.1 ± 0.71	5.0 ± 0.65	0.621
Pre-treatment GI, Mean ± SD	1.9 ± 0.21	1.9 ± 0.19	0.998

**Statistically significant (p < 0.05).*

Table 3: periodontal clinical parameters at baseline, 6 months and 12 months

Characteristic	Group I – Zirconia (n=20)	Group II – Lithium Disilicate (n=20)	p-value
Age (years), Mean ± SD	38.4 ± 7.2	37.9 ± 6.8	0.812
Sex (Male/Female)	9-Nov	10-Oct	0.752
Tooth type (Premolar/Molar)	8-Dec	13/7	0.744
Pre-treatment PPD (mm), Mean ± SD	4.8 ± 0.62	4.7 ± 0.58	0.573
Pre-treatment CAL (mm), Mean ± SD	5.1 ± 0.71	5.0 ± 0.65	0.621
Pre-treatment GI, Mean ± SD	1.9 ± 0.21	1.9 ± 0.19	0.998

**Statistically significant compared to baseline within group (p<0.001).*

Table 4: Patient satisfaction scores (visual analogue scale, 0–10)

VAS Parameter (0–10)	Group I – Zirconia Mean ± SD	Group II – Lithium Disilicate Mean ± SD	p-value
Aesthetics	7.4 ± 1.2	8.9 ± 0.9	0.001*
Comfort / Fit	8.6 ± 0.8	8.4 ± 0.9	0.432
Chewing efficiency	8.8 ± 0.7	8.5 ± 0.8	0.188
Overall satisfaction	8.2 ± 0.9	8.6 ± 0.8	0.128

**Statistically significant (p < 0.05).*

Discussion:

The present randomized controlled trial showed satisfactory 12-month clinical outcomes for both CAD/CAM zirconia and lithium disilicate crowns in root canal treated posterior teeth receiving periodontal therapy. The 100% survival rate for zirconia and 95% survival rate for lithium disilicate are consistent with the favourable performance reported for contemporary all-ceramic crowns **[10]**. Zirconia showed significantly higher fracture load than lithium disilicate, reflecting its superior mechanical strength and fracture resistance **[11].** The observed fracture resistance of both materials was above typical posterior masticatory forces, suggesting adequate mechanical performance for routine clinical use **[12]**. The higher aesthetic satisfaction with lithium disilicate may be attributed to its greater translucency and optical similarity to natural tooth structure **[13].** In contrast, conventional zirconia generally provides greater strength but comparatively lower translucency, although newer translucent formulations have improved its aesthetic properties **[14].** Both groups showed substantial improvements in probing pocket depth, clinical attachment level, gingival index, plaque index and bleeding on probing following periodontal therapy. The comparable periodontal outcomes suggest that both CAD/CAM ceramic materials can provide acceptable periodontal compatibility when appropriate marginal adaptation and plaque control are maintained **[15]**. Marginal adaptation was also favourable in both groups, supporting the precision achievable with CAD/CAM fabrication. The 6–8-week periodontal reassessment

before definitive crown placement may have contributed to stable periodontal conditions and favourable clinical outcomes. However, the small sample size and 12-month follow-up limit the ability to assess uncommon and long-term complications such as fatigue fracture, cement degradation and progressive periodontal changes. Further studies with larger samples and longer follow-up are required to confirm the comparative long-term performance of zirconia and lithium disilicate crowns.

Conclusion:
CAD/CAM zirconia and lithium disilicate crowns both performed satisfactorily over 12 months on root canal treated posterior teeth. Zirconia offered superior fracture resistance, while lithium disilicate gave better aesthetic satisfaction, with equivalent periodontal compatibility. Crown material should therefore be chosen based on the patient's aesthetic expectations and biomechanical demands.

Clinical significance:
The findings of this study provide clinically actionable guidance for prosthodontists and general dental practitioners managing root canal treated teeth in periodontally compromised patients. Zirconia is recommended for high-stress posterior restorations and in patients with parafunctional habits, while lithium disilicate is preferred in aesthetically sensitive premolar regions. The study underscores the critical importance of achieving periodontal stability prior to definitive crown placement and supports the integration of CAD/CAM technology into routine restorative practice for its precision, consistency and reduced chair time.

Advancement of knowledge:
This is the first randomized controlled trial to evaluate the concurrent restorative and periodontal outcomes of CAD/CAM zirconia and lithium disilicate crowns on root canal treated teeth within a unified clinical protocol. The study establishes that periodontal therapy does not differentially influence the performance of either crown type and confirms the clinical equivalence of both materials with respect to periodontal tissue compatibility.

Conflict of interest: The authors declare no conflicts of interest.

Source of funding: Self-funded. No external funding was received for this study.

Ethical approval:
Approved by the Institutional Ethics Committee, SMBT Dental College and Hospital (IEC Ref. No. SMBT/IEC/PROS/2022-23/07; March 10, 2023). CTRI Registration No.CTRI/2023/04/051248

Clinical trial number: CTRI/2023/04/051248.

References:
[1] Aswal GS *et al. Cureus*. 2023 **15**:e37888. [PMID: 37213959]
[2] Batra D *et al. Bioinformation*. 2025 **21**:361. [PMID: 40599937]
[3] Yuan Y & Chen P. *Medicine (Baltimore)*. 2025 **104**:e46421. [PMID: 41431058]
[4] https://pubmed.ncbi.nlm.nih.gov/42604435/
[5] Temizkan Nizaroglu R & Kucuk. *Niger J Clin Pract*. 2024 **27**:54. [PMID: 38317035]
[6] Vervack V *et al. J Esthet Restor Dent*. 2024 **36**:796. [PMID: 38152852]
[7] Alghamdi MA *et al. Journal of Posthumanism*. 2024 **4**:1318. [DOI: 10.63332/joph.v4i3.3241]
[8] Nafz P *et al. J Clin Periodontol*. 2026 **53**:520. [PMID: 41431295]
[9] Chen X *et al. J Clin Periodontol*. 2024 **51**:631. [PMID: 38317331]
[10] Benalcazar Jalkh EB *et al. J Esthet Restor Dent*. 2024 **36:**381. [PMID: 37676053]
[11] Jalalian E *et al. Saudi Dent J*. 2024 **36**:353. [PMID: 38420004]
[12] Ashour AM *et al. BMC Oral Health*. 2024 **24**:1065. [PMID: 39261857]
[13] Alasmari MA *et al. Heliyon*. 2024 **10**:e40757. [PMID: 39698071]
[14] Kang CM *et al. J Dent*. 2024 **145**:105023. [PMID: 38670331]
[15] Pachiou A *et al. Int J Comput Dent*. 2024 **27**:365. [PMID: 37477084]

Caveat Emptor is applicable among the literate community where required and possible. The publisher, its journal, editors and the internal/external reviewers take adequate steps to check, evaluate, correct, edit, revise and improve content where possible and required.