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RESEARCH AND EDUCATION

A two-year clinical trial of enamel wear opposing 5Y-TZP and lithium disilicate crowns

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ABSTRACT

Statement of problem. Clinical information on enamel wear opposing 5 mol% yttria-stabilized tetragonal zirconia polycrystal (5Y-TZP) or lithium disilicate crowns is lacking. Moreover, the effect of surface roughness on the wear of enamel antagonists remains unclear.

Purpose. The purpose of this clinical study was to quantify the vertical wear and total volume of wear while also measuring the surface roughness of antagonists at 6-month intervals over 2 years.

Material and methods. A tooth-supported first molar 5Y-TZP Lava Esthetic Fluorescent Zirconia crown or an IPS e.max CAD lithium disilicate crown was randomly provided for 24 participants (n=12). The contralateral first molar and opposite teeth were the natural enamel controls. The crowns were fabricated using computer-aided design and computer-aided manufacturing (CAD-CAM) technology and then polished. The data were gathered every 6 months at recall appointments with an intraoral scanner and a polyvinyl siloxane impression. A 3-dimensional (3D) comparative software program was used to measure the maximum vertical and volume loss on opposing enamel, as well as on the enamel control on the opposite side of the mouth. The surface of epoxy resin replicas was analyzed using a scanning electron microscope. The surface roughness of the cusp replica was measured with a 3D laser microscope. The crown's antagonist enamel and natural enamel wear were compared using a 2-way repeated measure ANOVA (α=.05).

Results. No significant difference was found in the average volume loss between the crown's antagonist enamel (ZTE 0.042 ±0.005 mm^3, LTE 0.048 ±0.006 mm^3) and the enamel control (ZCE 0.046 ±0.004 mm^3, LCE 0.050 ±0.005 mm^3) (P>.05). No significant difference was found in surface roughness between the crown's antagonist enamel (antagonist enamel of zirconia group [ZTE] 0.7 ±0.3 µm, antagonist enamel of lithium disilicate group [LTE] 0.6 ±0.3 µm) and the enamel control (enamel control of zirconia group [ZCE] 0.7 ±0.3 µm, enamel control of lithium disilicate group [LCE] 0.5 ±0.2 µm) in both zirconia and lithium disilicate groups (P>.05). Also, no correlation was found between the amount of wear and the roughness of the surface. The wear patterns observed on the opposing enamel surfaces of the monolithic zirconia and lithium disilicate materials were found to be similar to those seen on natural enamel.

Conclusions. A 2-year clinical investigation found that polished lithium disilicate and 5Y-TZP crowns did not affect enamel wear more than enamel against enamel, contrary to laboratory studies. Another finding revealed that surface roughness did not significantly affect wear. (J Prosthet Dent 2025;133:747-755)

The optimal material used for dental restorations should have the same wear characteristics as natural tooth enamel. However, some restorative materials are abrasive, leading to loss of tooth structure, dentin hypersensitivity, and vertical dimension reduction.[1–3] Computer-aided design and computer-aided manufacturing (CAD-CAM) monolithic translucent zirconia and lithium disilicate crowns have been widely used in contemporary dentistry. However, clinical studies concerning the effect of wear on natural antagonist teeth by these two types of crowns are scarce and inconclusive.

Laboratory investigations have demonstrated that lithium disilicate exhibits wear resistance and does not induce excessive wear on enamel.[4–11] Furthermore, in vivo studies revealed that the material can reduce the antagonist damage caused to enamel surfaces.[4,12]

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Clinical Implications

During the initial 2-year period of the clinical trial, no noteworthy wear of enamel was seen against either lithium disilicate or 5Y-TZP crowns.

However, since laboratory studies of wear use continuous loading instead of equilibrium tooth-to-tooth contacts and natural enamel exposed to lithium disilicate crown wear at different levels than natural enamel antagonists,[13] the results have been controversial. Furthermore, previous scanning electron microscopy (SEM) investigations showed that the antagonist enamel had a rougher and deeper pitted surface.[6,14]

A clinical study reported 38-µm per year enamel wear for molars.[15] Some clinical investigations involving monolithic zirconia crowns reported that the wear resulting from these crowns was greater than the wear that occurs with natural enamel.[16–18] Conversely, other research has reported no difference in wear between natural enamel and the enamel antagonist of monolithic zirconia.[19,20] Additionally, SEM images revealed that the worn enamel surface against polished zirconia was smooth.[21,22]

The quantity of clinical wear of a material and antagonist enamel cannot be solely accounted for by mechanical properties, as wear is a multifactorial phenomenon, and at least 2 parameters should be used concurrently when assessing wear.[23] To improve the understanding of material wear and its impact on enamel antagonists, the surface roughness of materials should be measured alongside the amount of wear.[24] The surface roughness of restorations has been reported to affect the wear of opposing teeth,[11,25–29] with surfaces with Ra values greater than 1.5 µm causing increased abrasive wear on opposing enamel.[28] However, this topic remains controversial, as enamel wear has been reported to vary considerably among materials with comparable surface roughness.[25]

Protocols for evaluating dental deterioration during periodic follow-ups have not been standardized,[30,31] with indirect techniques being used in most clinical investigations. These techniques, however, lack qualitative characteristics, are imprecise, and are subjective.[31,32] Intraoral scanners (IOSs) have been proposed as a method of quantifying dental wear and mitigating systematic errors.[30] IOSs showed promising sensitivity for dental wear diagnostics[33] and have been reported to be beneficial and can provide a systematic approach to evaluating wear in clinical settings.[34,35]

The aims of this research were to measure the vertical wear and volume of wear, as well as to assess the surface roughness of antagonist enamel at 6-month intervals over 2 years. The null hypotheses were that the wear of the crown's antagonist enamel and enamel control would not be different after 2 years of function, that the surface roughness of the crown's antagonist enamel and enamel control would not be different after 2 years of function, and that no correlation would be found between the amount of wear and the surface roughness.

MATERIAL AND METHODS

The Institutional Review Board's Ethics Committee, Faculty of Dentistry/Faculty of Pharmacy, Mahidol University, Bangkok, Thailand, approved this study (COA.NO.MU-DT/PY-IRB 2019/029.1505 and 2023/DT088). A split-mouth design was used (Fig. 1).

The sample size for this study was 24 individuals (n=12), based on values of σ=77 and Δ=76 (151–75) from a previous study.[17] The analysis was designed with a power of 80% and α=.05. Participants must have been at least 18 years old, healthy, and without dental limitation, temporomandibular joint problems, or parafunctional habits. Endodontically treated first molars requiring complete crowns were chosen, avoiding the risk of pulpal damage to vital teeth. One minimally restored tooth opposite the treated molar and 2 minimally restored first molars on the contralateral side were required. Occlusal restorations on these teeth were acceptable if the occlusal contacts were in enamel.[36] Participants signed an informed consent form prior to participating and ranged in age from 18 to 66 years old (mean 37, standard deviation 13); there were 6 men and 18 women. Participants were assigned to experimental groups using a 1:1 computer-generated randomization software program (Microsoft Excel; Microsoft Corp).

The single crowns were made of monolithic lithium disilicate glass-ceramic or monolithic translucent zirconia (Table 1) with tooth preparation and cementation techniques as described previously.[37] Coarse, medium, and fine diamond-impregnated polishers (ZilMaster; Shofu Dental Corp) were used to polish the entire occlusal surface. A postoperative evaluation was performed 1 week after crown cementation to determine the need for any modifications. An intraoral scanner with a precision of 4.5 ±0.9 µm[38] (TRIOS 3; 3Shape A/S) was used to collect quantitative wear data from the tooth and crown surfaces. Quadrant trays were used to make a 2-step double-mix silicone dental impression with high- and low-viscosity polyvinyl siloxane (Take 1 Advanced, Putty, and Light Body Wash; Kerr Corp) for surface roughness and surface characteristics. To create replicas, the dental impressions were filled with epoxy resin (SpeciFix-40; Struers). An 80-µm articulating paper (Hanel; Coltène) was used to identify the occlusal contacts before recording photographs. Participants were asked to return at 6, 12, 18, and 24 months (±2 weeks) to

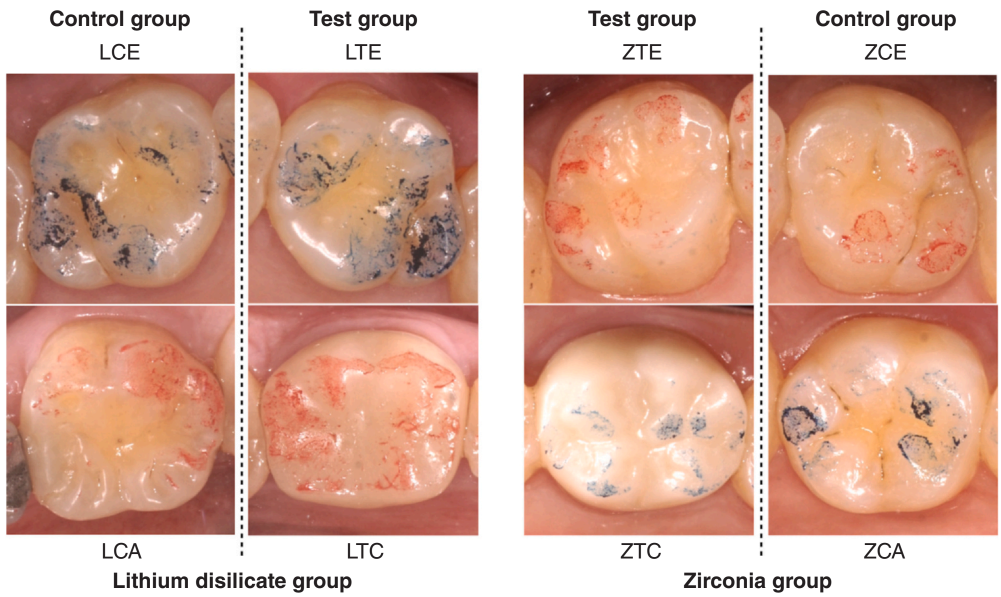

Figure 1. Split-mouth research design. LCA, antagonist enamel control of lithium disilicate group; LCE, enamel control of lithium disilicate group; LTC, crown of lithium disilicate group; LTE, antagonist enamel of lithium disilicate group; ZCA, antagonist enamel control of zirconia group; ZCE, enamel control of zirconia group; ZTC, crown of zirconia group, ZTE; antagonist enamel of zirconia group.

Table 1. Material used

Material	Type	Manufacturer	Translucency	Lot	Composition (in % by weight)
Lava Esthetic Fluorescent FC	5 mol% Y-TZP	3 M ESPE	High	7604458	ZrO_2 + HfO_2 ≥89.0, Y_2O_3 6.0% to 11.0, Al_2O_3 ≤0.5, Other oxides ≤2.0
IPS e.max CAD	Lithium disilicate glass-ceramic	Ivoclar AG	Low	W36523	SiO_2 57.0 to 80.0, Li_2O 11.0 to 19.0, K_2O 0.0 to 13.0, P_2O_5 0.0 to 11.0, ZrO_2 0.0 to 8.0, ZnO 0.0 to 8.0, Al_2O_3 0.0 to 5.0, MgO 0.0 to 5.0, Coloring oxides 0.0 to 8.0

collect data. Maximal vertical loss (µm) and volume loss (mm^3) were measured using software programs (GOM Inspect; GOM GmbH, NX; SIEMENS), as detailed previously (Fig. 2).[37]

The epoxy resin replicas were dried and sputter coated with gold, and the wear patterns were determined with a scanning electron microscope (JSM-6610 Series; JEOL) with magnifications of ×20 to ×100 for surface analysis of the occlusal contact areas (OCAs). After scanning electron microscope (SEM) examination, the molar epoxy resin specimens were sectioned into 4 or 5 pieces along the central grooves to investigate surface roughness. The cusp replica was placed in putty (Silagum Putty; Accord Corp) and loaded into a loading machine, which aligned the specimen's occlusal contact surface with the horizontal plane. The surface topography and roughness (µm) were measured using a 3-dimensional (3D) measuring laser microscope (LEXT OLS5100; Olympus). Each specimen underwent 3 equidistant parallel measurements, and the average Ra value for each specimen was recorded (Fig. 3).

The statistical analysis was performed using a statistical software program (IBM SPSS Statistics, v28.0; IBM Corp). To compare the 2 variables: tooth (TE, antagonist enamel; TC, crown; CE, enamel control; CA, antagonist enamel control) and time (6 M, 12 M, 18 M, 24 M), a 2-way repeated measure ANOVA within-subjects variables (tooth, time) and between-subjects factor (Z, zirconia group; L, lithium disilicate group) was performed. Pearson correlations were used to determine the relationship between maximum vertical loss, volume loss, and surface roughness (α=.05).

RESULTS

Outcomes were determined for 20 participants (10 per group). Antagonistic enamel cracking led to 1 participant

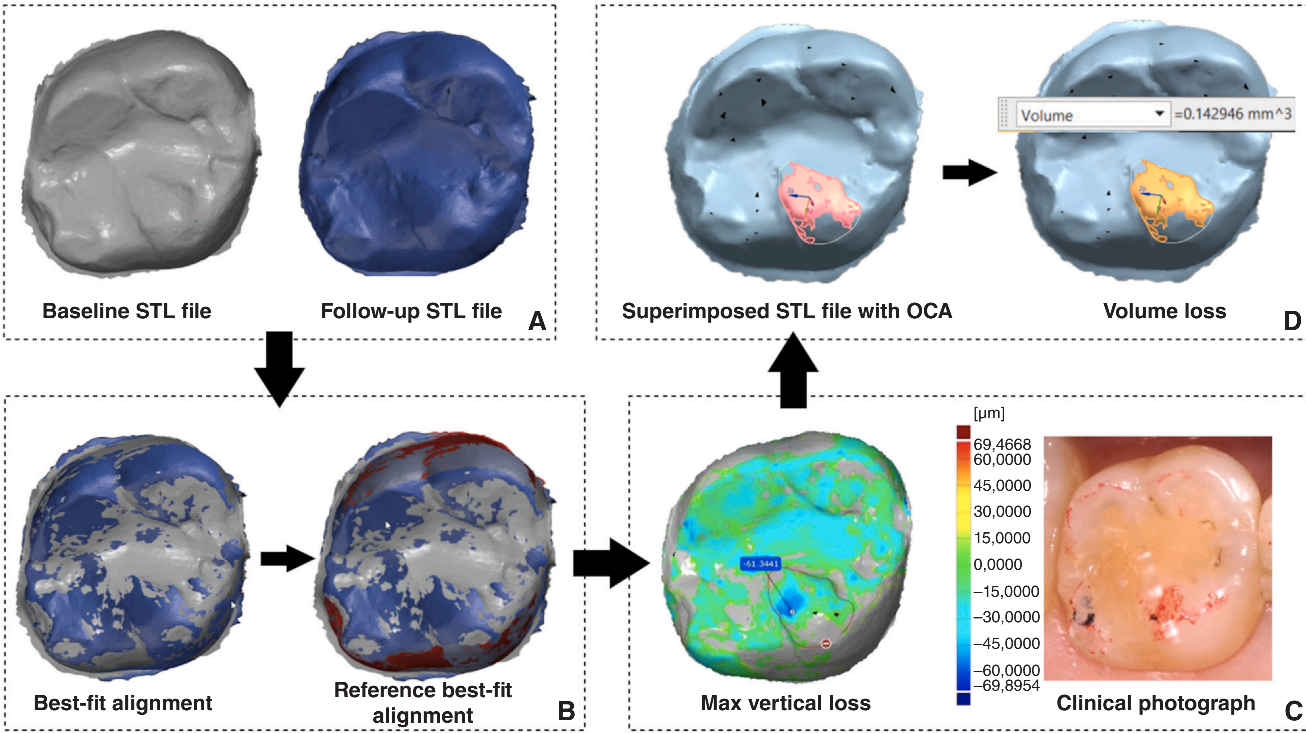

Figure 2. Maximum vertical loss and volume loss measurement. OCA, occlusal contact area; STL, stereolithography.

withdrawing, and 3 participants were not available to provide follow-up data. (Fig. 4).

The average maximum vertical loss in enamel did not differ significantly between the control (CE) and antagonist (TE) surfaces of either zirconia (Z) or lithium disilicate (L) groups (P>.05). However, the antagonist enamel (TE) showed a significant difference in wear between zirconia (Z) and lithium disilicate (L) groups

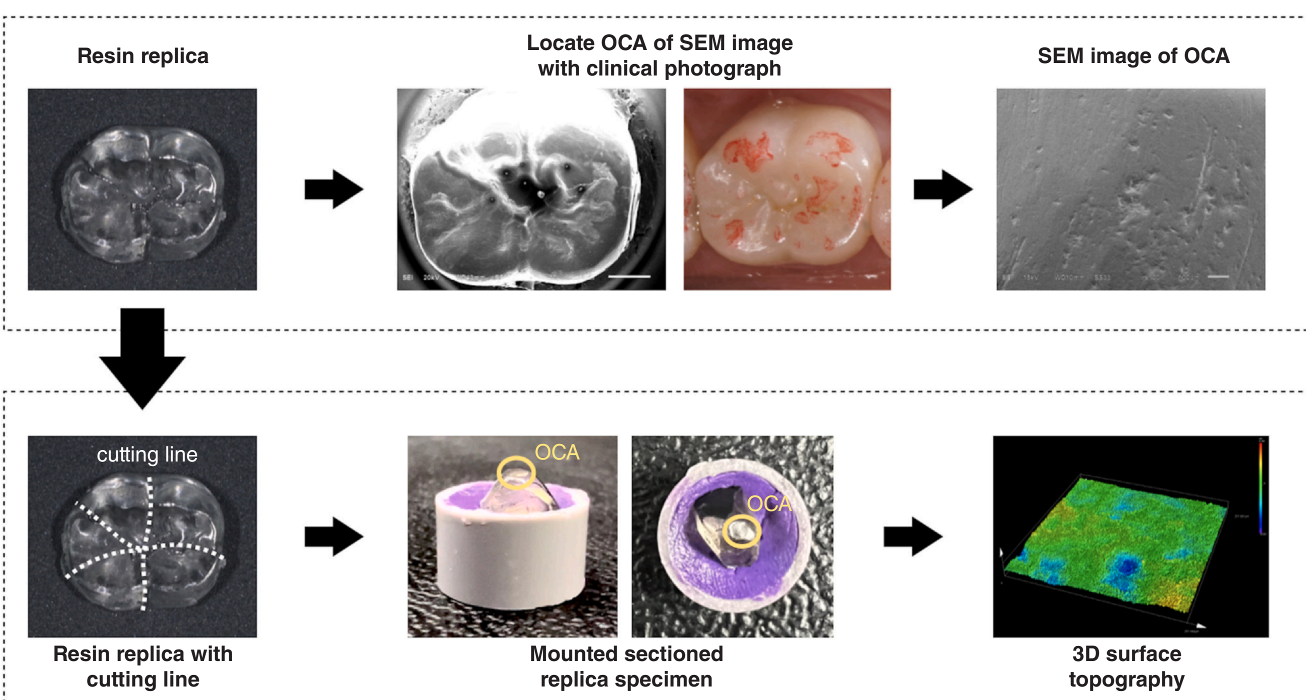

Figure 3. SEM, surface roughness, and surface topography analysis. OCA, occlusal contact area; SEM, scanning electron microscopy.

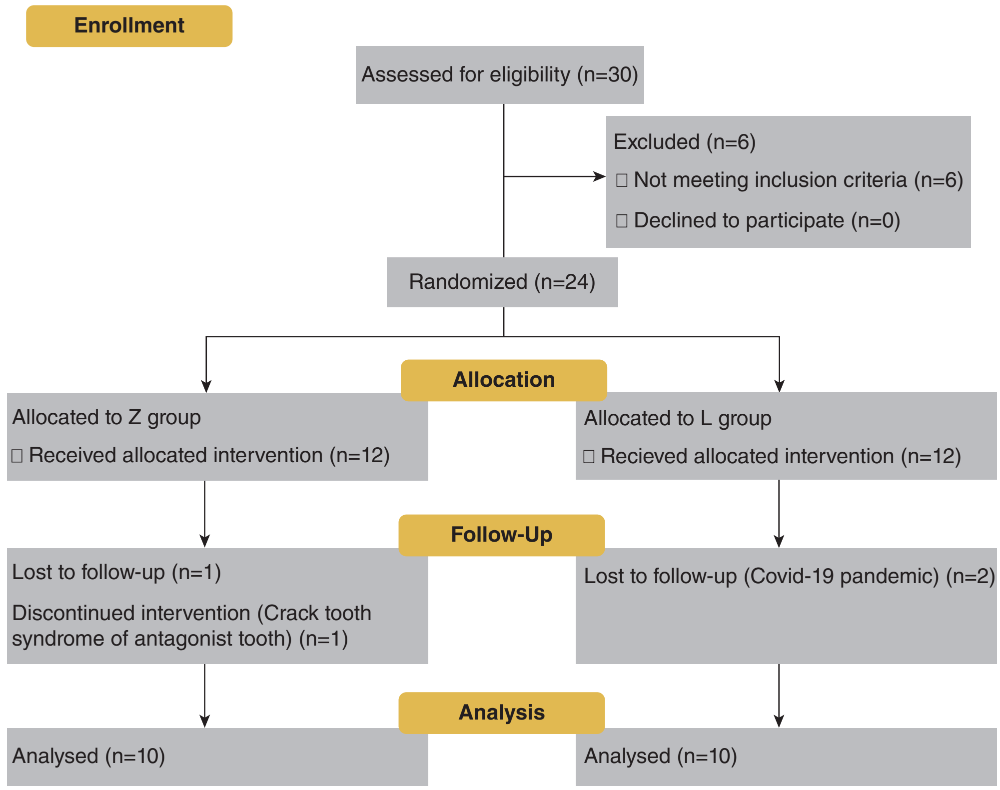

Figure 4. CONSORT flowchart. L, lithium disilicate; Z, zirconia.

Table 2. Mean (SD) of maximum vertical loss (µm) and *P* values

		6 M	12 M	18 M	24 M
Z	TC	19.5 (2.9)	22.3 (2.7)	24.3 (3.1)	26.1 (2.9)
	TE	29.8 (6.9)	34.8 (5.6)	40.6 (7.1)	45.2 (4.8)
	CE	30.1 (3.4)	34.2 (3.0)	37.7 (4.0)	41.6 (4.5)
	CA	31.2 (2.7)	33.8 (5.7)	37.8 (6.2)	41.3 (6.2)
	P	<.001	<.001	<.001	<.001
Z	TC vs TE	.003	.001	<.001	<.001
	TE vs CE	>.999	>.999	.752	.147
	CE vs CA	>.999	>.999	>.999	>.999
		6 M	**12 M**	**18 M**	**24 M**
L	TC	30.2 (4.6)	35.8 (5.2)	38.6 (6.0)	43.4 (6.1)
	TE	37.0 (7.1)	43.3 (7.4)	48.5 (6.3)	53.6 (5.6)
	CE	33.2 (6.0)	39.8 (5.8)	44.5 (6.6)	51.9 (7.7)
	CA	34.4 (6.2)	41.5 (5.9)	47.0 (7.7)	51.9 (7.9)
	P	.086	.064	.016	.001
L	TC vs TE	.081	.078	.008	.001
	TE vs CE	.229	.293	.213	>.999
	CE vs CA	>.999	>.999	>.999	>.999

CA, antagonist enamel control; CE, enamel control; L, lithium disilicate group; TC, crown; TE, antagonist enamel; Z, zirconia group.

(P<.05). The mean maximum wear showed a significant increase over the recall period (every 6 months, P<.05) (Tables 2, 3).

Enamel wear analysis revealed no significant difference in volume loss between the antagonist enamel (TE) and the control enamel (CE) within either the zirconia (Z) or lithium disilicate (L) groups at any time point (P>.05). However, the antagonist enamel (TE) of the zirconia group showed significantly greater wear compared with the lithium disilicate group at 24 months (P<.05). Additionally, significant wear progression was observed over the entire recall period (every 6 months) for all groups (P<.05) (Tables 3, 4).

Analysis of surface roughness showed no significant difference between the antagonist enamel (TE) and control enamel (CE) for either zirconia (Z) or lithium disilicate (L) groups (P>.05). Additionally, the antagonist enamel (TE) itself exhibited no significant difference in roughness between the 2 material groups (P>.05). However, surface roughness changed significantly between the 2 recall appointments for all groups (P<.05) (Tables 3, 5).

Table 3. Comparison between Z and L groups in different teeth and times

		P			
		6 M	12 M	18 M	24 M
Max. vertical loss					
Z vs L					
	TC	<.001	<.001	<.001	<.001
	TE	.033	.010	.017	.002
	CE	.178	.015	.013	.002
	CA	.136	<.001	.009	.004
Volume loss					
Z vs L					
	TC	<.001	<.001	<.001	<.001
	TE	.431	.058	.367	.028
	CE	.512	.308	.091	.056
	CA	.898	.203	<.001	.005
Surface roughness					
Z vs L					
	TC	.720	.732	.836	.345
	TE	.174	.489	.253	.708
	CE	.129	.295	.281	.101
	CA	.207	.037	.190	.370

CA, antagonist enamel control; CE, enamel control; L, lithium disilicate group; TC, crown; TE, antagonist enamel; Z, zirconia group.

Analysis of correlations revealed a moderate relationship between vertical loss and volume loss after 24 months for the antagonist enamel in both the zirconia ($r=-0.726$, $P<.05$) and lithium disilicate groups ($r=0.649$, $P<.05$). However, no significant correlation was found between occlusal wear and surface roughness of the antagonist enamel, crowns, or natural enamel.

SEM images captured at baseline (0 month) and after 24 months revealed distinct surface characteristics for each material (Fig. 5). The natural enamel control (CE) exhibited a rough appearance with deep pits (Fig. 5A, B). The zirconia crown (ZTC) surface appeared uneven (Fig. 5C, D) The antagonist enamel opposing the zirconia crown (ZTE) showed a rougher surface with larger wear patterns likely caused by the accumulation of small pits (Fig. 5E, F). In contrast, the lithium disilicate crown (LTC) displayed wear features with chipping of the lithium disilicate material (Fig. 5G, H). The antagonist enamel opposing the lithium disilicate crown (LTE) presented a wear facet with a deeper and coarser pitted surface compared with the control (Fig. 5I, J).

Table 5. Mean (SD) of surface roughness differences (μm) and P values

		6 M	12 M	18 M	24 M
Z	TC	0.1 (0.1)	0.2 (0.2)	0.3 (0.2)	0.5 (0.2)
	TE	0.2 (0.2)	0.3 (0.2)	0.4 (0.0)	0.7 (0.3)
	CE	0.2 (0.1)	0.3 (0.2)	0.5 (0.3)	0.7 (0.4)
	CA	0.2 (0.1)	0.5 (0.3)	0.6 (0.3)	0.7 (0.4)
	P	.376	.013	.005	.069
Z	TC vs TE	.463	>.999	>.999	.706
	TE vs CE	>.999	>.999	.422	>.999
	CE vs CA	>.999	.905	>.999	>.999
		6 M	12 M	18 M	24 M
L	TC	0.1 (0.1)	0.2 (0.1)	0.3 (0.2)	0.6 (0.6)
	TE	0.1 (0.1)	0.3 (0.1)	0.4 (0.1)	0.6 (0.3)
	CE	0.1 (0.1)	0.3 (0.2)	0.4 (0.2)	0.5 (0.2)
	CA	0.1 (0.1)	0.2 (0.1)	0.4 (0.2)	0.6 (0.0)
	P	.859	.902	.609	.690
L	TC vs TE	>.999	>.999	>.999	>.999
	TE vs CE	>.999	>.999	>.999	>.999
	CE vs CA	>.999	>.999	>.999	>.999

CA, antagonist enamel control; CE, enamel control; TC, crown; TE, antagonist enamel.

Three-dimensional surface topography analysis of the natural enamel (OCA) revealed increased roughness and deeper pitting over time (Fig. 6A, B). The lithium disilicate crown (LTC) exhibited progressive surface irregularity with a growing number of pits (Fig. 6C, D). The antagonist enamel (LTE) opposing the LTC also showed increased pitting and an uneven surface (Fig. 6E, F). In contrast, the zirconia crown (ZTC) surface remained unchanged (Fig. 6G, H). However, the antagonist enamel (ZTE) opposing the ZTC displayed progressive surface roughness and an accumulation of microscopic pits forming more potholes (Fig. 6I, J).

DISCUSSION

This study revealed no significant difference in volume wear of the antagonist enamel between natural teeth and those opposing either zirconia or lithium disilicate

Table 4. Mean (SD) of volume loss (mm^3) and *P* values

		6 M	12 M	18 M	24 M
Z	TC	0.008 (0.003)	0.011 (0.004)	0.015 (0.007)	0.019 (0.005)
	TE	0.023 (0.008)	0.029 (0.007)	0.039 (0.005)	0.042 (0.005)
	CE	0.025 (0.007)	0.030 (0.007)	0.037 (0.006)	0.046 (0.004)
	CA	0.024 (0.009)	0.030 (0.006)	0.036 (0.005)	0.044 (0.006)
	P	<.001	<.001	<.001	<.001
Z	TC vs TE	<.001	<.001	<.001	<.001
	TE vs CE	>.999	>.999	>.999	.788
	CE vs CA	>.999	>.999	>.999	.312
		6 M	12 M	18 M	24 M
L	TC	0.026 (0.008)	0.033 (0.004)	0.036 (0.004)	0.042 (0.004)
	TE	0.026 (0.008)	0.037 (0.010)	0.041 (0.007)	0.048 (0.006)
	CE	0.028 (0.008)	0.034 (0.009)	0.042 (0.006)	0.050 (0.005)
	CA	0.024 (0.008)	0.033 (0.005)	0.045 (0.003)	0.051 (0.004)
	P	.780	.641	.008	<.001
L	TC vs TE	>.999	>.999	.466	.078
	TE vs CE	>.999	>.999	>.999	>.999
	CE vs CA	>.999	>.999	.404	>.999

CA, antagonist enamel control; CE, enamel control; L, lithium disilicate group; TC, crown; TE, antagonist enamel; Z, zirconia group.

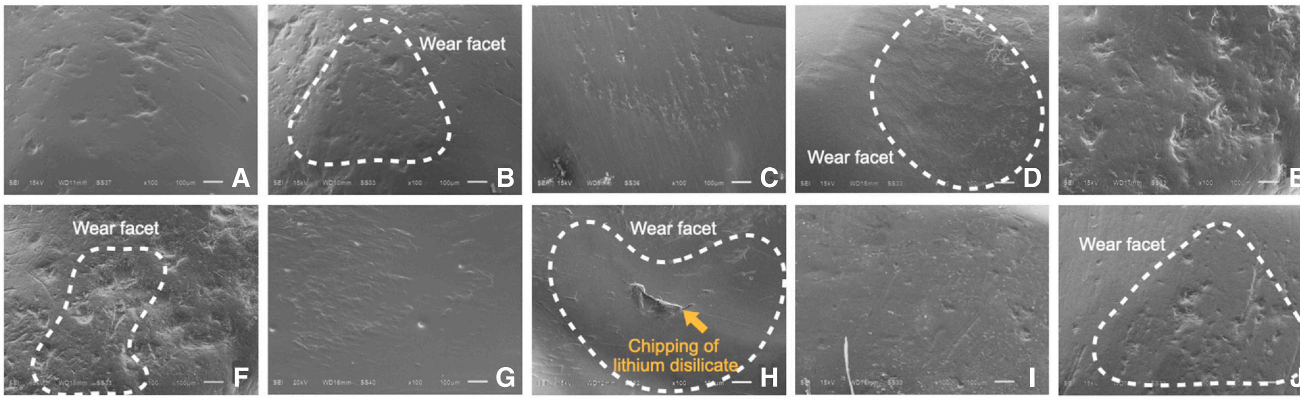

Figure 5. Scanning electron microscope image of occlusal contact areas of A-B natural enamel; C-D zirconia crown; E-F zirconia crown's antagonist enamel; G-H lithium disilicate crown; I-J lithium disilicate crown's antagonist enamel, at 0 M and 24 M, original magnification ×100.

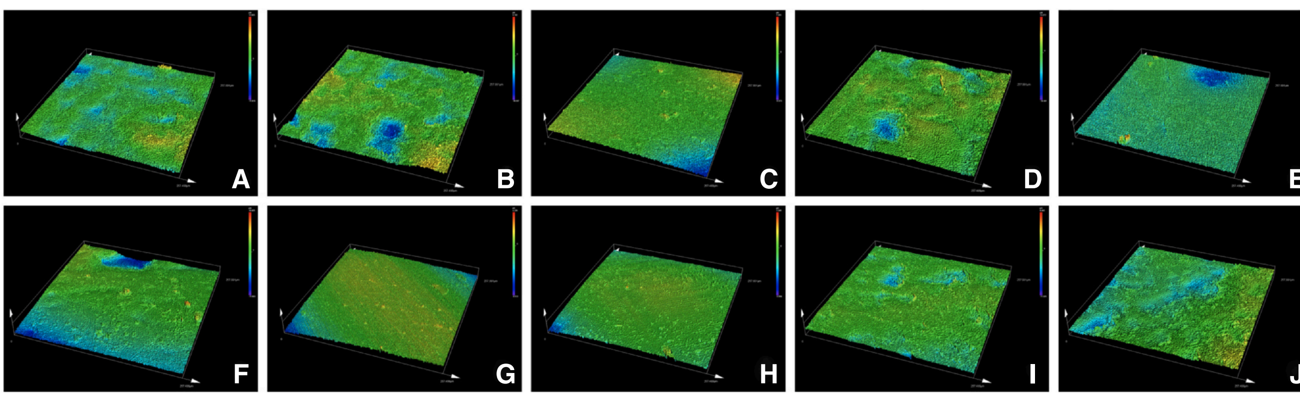

Figure 6. Three-dimensional surface topography of occlusal contact areas of A-B natural enamel; C-D lithium disilicate crown; E-F lithium disilicate crown's antagonist enamel; G-H zirconia crown; and I-J zirconia crown's antagonist enamel, at 0 M and 24 M.

crowns after 2 years. In addition, the surface roughness of the crown antagonist enamel in both groups did not differ significantly from the control enamel. Moreover, the study found no correlation between surface roughness and wear when compared. Therefore, the 3 null hypotheses were not rejected.

The 5 mol% Y-TZP crown did not result in greater enamel antagonist wear than natural tooth wear, based on vertical and volume loss analysis, Although the findings of this study were consistent with previous research,[19,20] they were inconclusive because of variations in zirconia use across studies. Further research investigating the clinical implications of 3, 4, and 5 mol% Y-TZP crowns on wear outcomes would be valuable.

In addition, the wear of enamel antagonists in the L group was not different when compared with that of natural enamel. This result was consistent with both laboratory and clinical studies.[4–12] As a result, it can be concluded that the effects of enamel antagonist wear caused by lithium disilicate crowns are comparable with those observed in unrestored teeth.

Both zirconia (Z) and lithium disilicate (L) groups were found to exhibit similar antagonist enamel wear to natural teeth. Additionally, no new premature contacts were observed on opposing enamel or crown surfaces during the 6-month follow-up intervals. This suggests that the use of a polished, rather than glazed, crown surface may contribute to reduced wear and improved occlusal contact.

A progressive increase in antagonist enamel wear was found for both zirconia (Z) and lithium disilicate (L) groups over the 2-year follow-up period, with wear measured every 6 months. This aligns with the established concept of a running-in wear stage in tribology, as described in previous research.[39,40] However, the exact duration of this running-in wear stage for enamel antagonists in the mouth remains unclear, with reports varying from 6 months[16,40] to 12 or 24 months.[17,39] Therefore, longitudinal studies are essential to determine the time it takes for antagonist enamel to reach a steady-state wear pattern. Additionally, investigating methods to accelerate this transition, potentially through material property modifications, could be a valuable area for future research.

A corresponding increase in both surface roughness and volume loss of the antagonist enamel was found over the 2-year period, consistent with prior studies suggesting a relationship between increased roughness and wear.[11,25–28] While surface roughness likely influences the wear process, this finding, along with previous research,[24,26,28,41] indicates it may not be the most critical factor determining wear extent. This lack of a clear correlation between roughness and wear highlights the ongoing debate about its true impact.

Surface roughness was calculated using the average difference between baseline and follow-up values. In clinical settings, the natural enamel and the crown cannot have the same starting surface roughness. This differs from laboratory experiments, in which default values can be assigned uniformly. Hence, claiming that the surface roughness values obtained in this investigation are consistent with those of a previous study that found a correlation between the presence of asperities on a surface with a Ra value greater than 1.5 and the potential for increased abrasive wear on antagonist enamel is not possible.[28]

Quantifying wear alone provides limited insight into the underlying mechanisms. Examining both material surface properties and enamel characteristics is essential for understanding wear progression and predicting future loss. These findings, consistent with previous research,[6] revealed a rougher enamel surface with pitting when enamel opposed enamel. This surface characteristic, along with the established knowledge of subsurface microcrack formation and subsequent particle dislodgement,[42,43] suggests abrasive wear as the primary contributor to the enamel wear observed in this study.

The study's findings revealed that the lithium disilicate crown had a rougher and more pitted surface, as well as chipping in the lithium disilicate fragment. These findings were consistent with those of earlier research.[5,7,41] Furthermore, surface topography and SEM studies of the antagonist enamel revealed a rougher, deeper pitted surface, consistent with previous research.[6,14] The microstructure of lithium disilicate includes glass and crystalline needles, and these 2 components plow the enamel surface until it deforms, resulting in an abrasive surface and encouraging wear.[14] Moreover, the detachment of glass particles during the wear process may cause them to behave as an abrasive medium, contributing to the formation of a 3-body wear mechanism.[43]

The SEM image of the antagonist enamel of the zirconia crown revealed a surface with increased pitting and roughness, which contradicted previous clinical research that found no cracks in the enamel antagonist to a zirconia crown.[36] A laboratory study reported that the enamel wear scar against polished zirconia was smooth, with numerous microscopic enamel chips, tiny reticular cracks, and a pit-like structure.[22] Based on these characteristics, an extended experiment could transform fatigue wear into abrasive wear, as enamel flakes break off and act as a 3-body wear, resulting in surface features similar to those observed in the current study.

The SEM images of the OCA of the zirconia crown revealed that the wear facet had an irregular surface. However, there were no observable alterations in the surface topography. This finding contradicted the findings of a previous study, which reported no evidence of surface fracture or roughening during the 5Y-TZP wear process.[21] When surface features are studied in conjunction with wear and Ra values, the results may be attributed to zirconia's high strength and toughness.[22] This could explain the surface alteration of monolithic zirconia caused by the opposing enamel, which was observed in this investigation.

Limitations of this study included the approach to precise and reliable wear assessment, which involves isolating a single tooth from an entire dental scan and then examining it, as described previously.[27,28] In the future, the development of a technology capable of analyzing the total amount of dental wear at the same time would most likely increase its utility. Another limitation was that current techniques necessitate cutting only the occlusal contact region of the resin specimen to obtain the most horizontal plane for surface roughness assessment with a 3D laser microscope. In the future, a methodology or technological advancement should be developed that allows for the direct assessment of surface roughness based on the tooth surface. Moreover, because of the current study's small sample size, specific selection criteria, and 2-year observation period, it may be difficult to determine how long it takes for wear tribology to stabilize after crown insertion. These points highlight key areas for future research.

CONCLUSIONS

Based on the findings of this 2-year clinical trial, the following conclusions were drawn:

1. Polished lithium disilicate and 5Y-TZP crowns had no greater effect on enamel wear than enamel against enamel, contrary to laboratory studies.
2. Wear was unaffected by surface roughness.
3. Polished lithium disilicate and 5Y-TZP crowns can be used clinically without damaging the opposing enamel.

PATIENT CONSENT

Informed patient consent has been obtained.

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