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Evaluation of Glazing and Polishing Systems for Novel Chairside CAD/CAM Lithium Disilicate and Virgilite Crowns

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Clinical Relevance

A new dental ceramic consists of a combination of lithium disilicate and virgilite. However, little information is available on how to polish this ceramic. We showed that zirconia polishing systems provided smoother and more clinically acceptable surfaces than the lithium disilicate kits.

SUMMARY

Objective: The purpose of this study was to evaluate the effectiveness of glazing, two zirconia, and two lithium disilicate polishing systems on surface roughness of a CAD/CAM lithium disilicate and virgilite ceramic with atomic force microscopy (AFM) and visual assessment performed by dental students and faculty.

Methods and Materials: Sixty maxillary right central incisor crowns made of a novel chairside CAD/CAM lithium disilicate and virgilite (CEREC Tessera) were milled for glazing and polishing.

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The crowns were divided into six groups: no polishing/glazing provided (NoP/G); glazed (GZ); glazed and polished with Brasseler Dialite LD Lithium Disilicate (DiLD); glazed and polished with Meisinger Luster Lithium Disilicate (LuLD); glazed and polished with Brasseler Dialite ZR Zirconia (DiZR); and glazed and polished with Meisinger Luster Zirconia (LuZR). Surfaces were scanned with AFM to measure roughness (Ra) and root mean square roughness (Rq) and generate micrographs. Crowns were visually assessed by 10 dental students and 10 dental school faculty members to determine clinical acceptableness.

Results: Glazing and all polishing kits significantly reduced Ra and Rq compared to no polishing/glazing. No significant Ra differences were found between glazing and all polishing kits (p>0.05). DiZR significantly reduced Rq compared to other groups (p<0.05). Visual assessment showed that GZ, LuLD, and DiZR were the most clinically acceptable crowns.

Conclusion: Polishing and glazing considerably improve the surface smoothness of maxillary central incisor crowns fabricated out of a chairside CAD/CAM lithium disilicate and virgilite ceramic. Altogether, zirconia polishing systems provided smoother and more clinically acceptable surfaces than the lithium disilicate kits.

INTRODUCTION

Development of chairside computer-aided design and computer-aided manufacturing (CAD/CAM) restorations was started by Dr Mormann and Dr Brandestini in the late 1970s and Dr Duret later fabricated the first posterior crown in 1985.[1,2] CAD/CAM systems developed from simple 2D monitors to advanced 3D monitors with the capability to fabricate restorations in a single appointment.[3-5] Clinicians have a variety of ceramics to fulfill patients' esthetic demands with the wide applications provided by chairside CAD/CAM.[6-8] However, subtractive CAD/CAM technology does not create smooth surfaces and restorations need finished and polished or glazed before cementation.[9,10]

Lithium disilicate for chairside CAD/CAM systems was introduced in 2006 with IPS e.max CAD and has become a very popular material in recent years because many types of restorations can be fabricated.[11,12] CAD-CAM lithium disilicate has clinically acceptable marginal fit and long-term success rates.[13,14] IPS e.max CAD contains both 40% lithium metasilicate (Li_2SiO_3) crystals and lithium disilicate ($Li_2Si_2O_5$) crystal nuclei and is available in different shades and grades of translucency according to the size and density of the crystals.[15-17] This ceramic is manufactured in a precrystallized state and thus needs sintering for 20 to 25 minutes before cementing the restoration.[18,19]

Other chairside CAD/CAM lithium disilicates have been recently introduced in the market with significant differences from the pioneering material (IPS e.max CAD). One of the newest dental ceramics available with a combination of lithium disilicate and virgilite (Cerec Tessera, Dentsply Sirona) consisting of 40-45% glass with particle sizes of 0.5 microns; the composition is distributed between 90% lithium disilicate crystals, 5% lithium phosphate, and 5% virgilite crystals of around 100 nanometers.[20] The CAD/CAM block comes in a pre-crystallized state and needs to be glazed on a honeycomb firing tray during the rapid sintering cycle recommended by the manufacturer.[21]

The final surface finish is important to the clinical function of CAD/CAM ceramic materials. Dental ceramic's relatively high hardness, frictional resistance, and porosity can significantly increase wear against natural dentition, affect vertical dimension or occlusion, and cause sensitivity.[10,18] Smoother surfaces retain less plaque and biofilm load and tend to show better gingival tissue responses than rougher surfaces.[6,8] Glazing and polishing can reduce these detrimental effects but the literature is inconsistent as to which finishing technique is ideal. The final surface quality can also affect the gloss, color stability, and translucency of dental ceramics.[4,9]

Unfortunately, very limited data for this novel material is available to guide clinicians on how to finish the surface. Indeed, a PubMed search provided no studies examining surface finishing. The manufacturer does not produce polishing systems and therefore no recommendations exist for processing the material after milling. Therefore, this study aimed to compare the effect of glazing and two lithium disilicate and two zirconia polishing systems for maxillary right central incisor crowns fabricated out of CEREC Tessera. The first null hypothesis is that there is no difference between glazing and all polishing systems assessed. The second null hypothesis is that there is no difference between lithium disilicate and zirconia polishing systems. The alternative hypothesis is that glazing and all polishing systems provide smoother surfaces than non-polished crowns.

METHODS AND MATERIALS

Specimen Preparation

A maxillary right central incisor typodont tooth

(Columbia Dentoform, Long Island City, NY, USA) was prepared for a full-coverage ceramic crown with a chamfer margin (1.0 mm) and incisal reduction (1.0 mm). The prepared tooth was scanned with a chairside CAD/CAM scanner (CEREC Primescan, Dentsply Sirona, Charlotte, NC, USA). Sixty crowns were milled (CEREC MCXL, Dentsply Sirona) from lithium disilicate and virgilite ceramic (CEREC Tessera, Dentsply Sirona) and divided into six groups (n=10/ group) as follows: (1) no glaze and no polish (NoG/P); (2) glazed with Universal Spray Glaze Fluo (Dentsply Sirona [GZ]); (3) glazed and polished with Dialite LD Lithium Disilicate (Brasseler, Savannah, GA, USA [DiLD]); (4) glazed and polished with Luster Lithium Disilicate (Meisinger, Centennial, CO, USA [LuLD]); (5) glazed and polished with Dialite ZR Zirconia (Brasseler [DiZR]); and (6) glazed and polished with Luster Zirconia (Meisinger [LuZR]). The materials and protocols used to prepare the specimens can be seen in Table 1. The specimens in group 2 were glazed and fired for 15 minutes following the manufacturers' recommended application protocol. The surface of the specimens in groups 3-6 was mechanically polished with long horizontal strokes with minimal pressure using a dental laboratory handpiece set to rotate the polishers in a clockwise direction. The sequence of polishing points and revolutions per minute (RPM) recommended by the manufacturer was used for each polishing system. A total of 10 strokes on each surface were performed on the cervical, medial, and incisal third of the labial surface of the specimens. Subsequently, a small marking was created near the center of the buccal surface approximately 5 mm above

Table 1: *Materials Used in This Study*

Group	Treatment	Manufacturer	Description	Manufacturer Instructions
Group 1 (NoG/P)	No glaze/polish	None	None	None
Group 2 (GZ)	Glazed with Universal Spray Glaze Fluo	Dentsply Sirona, Charlotte, NC, USA	Fluorescent Spray Glaze consisting of silicate glass, isopropyl alcohol, isobutane propellant, and fluorescing agent	Glaze spray is applied to restorations at a 10 cm distance. Subsequently, the restorations were fired using the "glaze" program in the dental laboratory ceramic furnace.
Group 3 (DiLD)	Glazed and polished with Dialite LD Lithium Disilicate	Brasseler USA, Savannah, GA, USA	Three-step porcelain polishing system Medium grit (red); Polyurethane bound with medium/coarse diamond grains fine grit (yellow): Polyurethane bound with fine diamond grains	Medium grits (red) for pre-polishing and fine grits (yellow) for final polishing. Speed: 5000-7000 rpm. May be used dry with a feather touch or wet.
Group 4 (LuLD)	Glazed and polished with Luster Lithium Disilicate	Meisinger USA, Centennial, CO, USA	Two-step porcelain polishing system Specific details of the abrasive and binder not disclosed by the manufacturer Medium grit (red) and high shine (grey)	Target smoothing of the occlusal surface using the medium grits (red) for pre-polishing, then the fine grits for high shine (grey) without high pressure for final polishing. Speed: 10,000-15,000 rpm.

(Columbia Dentoform, Long Island City, NY, USA) was prepared for a full-coverage ceramic crown with a chamfer margin (1.0 mm) and incisal reduction (1.0 mm). The prepared tooth was scanned with a chairside CAD/CAM scanner (CEREC Primescan, Dentsply Sirona, Charlotte, NC, USA). Sixty crowns were milled (CEREC MCXL, Dentsply Sirona) from lithium disilicate and virgilite ceramic (CEREC Tessera, Dentsply Sirona) and divided into six groups (n=10/ group) as follows: (1) no glaze and no polish (NoG/P); (2) glazed with Universal Spray Glaze Fluo (Dentsply Sirona [GZ]); (3) glazed and polished with Dialite LD Lithium Disilicate (Brasseler, Savannah, GA, USA [DiLD]); (4) glazed and polished with Luster Lithium Disilicate (Meisinger, Centennial, CO, USA [LuLD]); (5) glazed and polished with Dialite ZR Zirconia (Brasseler [DiZR]); and (6) glazed and polished with Luster Zirconia (Meisinger [LuZR]). The materials and protocols used to prepare the specimens can be seen in Table 1. The specimens in group 2 were glazed and fired for 15 minutes following the manufacturers' recommended application protocol. The surface of the specimens in groups 3-6 was mechanically polished with long horizontal strokes with minimal pressure using a dental laboratory handpiece set to rotate the polishers in a clockwise direction. The sequence of polishing points and revolutions per minute (RPM) recommended by the manufacturer was used for each polishing system. A total of 10 strokes on each surface were performed on the cervical, medial, and incisal third of the labial surface of the specimens. Subsequently, a small marking was created near the center of the buccal surface approximately 5 mm above

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Group 3 (DiLD)	Glazed and polished with Dialite LD Lithium Disilicate	Brasseler USA, Savannah, GA, USA	Three-step porcelain polishing system Medium grit (red); Polyurethane bound with medium/coarse diamond grains fine grit (yellow): Polyurethane bound with fine diamond grains	Medium grits (red) for pre-polishing and fine grits (yellow) for final polishing. Speed: 5000-7000 rpm. May be used dry with a feather touch or wet.
Group 4 (LuLD)	Glazed and polished with Luster Lithium Disilicate	Meisinger USA, Centennial, CO, USA	Two-step porcelain polishing system Specific details of the abrasive and binder not disclosed by the manufacturer Medium grit (red) and high shine (grey)	Target smoothing of the occlusal surface using the medium grits (red) for pre-polishing, then the fine grits for high shine (grey) without high pressure for final polishing. Speed: 10,000-15,000 rpm.

Table 1: *Materials Used in This Study (cont.)*

Group	Treatment	Manufacturer	Description	Manufacturer Instructions
Group 5 (DiZR)	Glazed and polished with Dialite ZR Zirconia	Brasseler USA, Savannah, GA, USA	Two-step porcelain polishing system Medium grit (green): Polyurethane bound impregnated with high-concentration, medium-fine diamond grains Fine grit (orange): Polyurethane bound impregnated with high-concentration of fine diamond grains	Medium grits (green) for pre-polishing and fine grits (orange) for final polishing. Speed: 8000-10,000 rpm. Reduce speed by half for final polish.
Group 6 (LuZR)	Glazed and polished with Luster Zirconia	Meisinger USA, Centennial, CO, USA	Two-step porcelain polishing system Diamond impregnated Specific details of the abrasives and binder not disclosed by the manufacturer Medium grit (blue) - High shine (pink)	Target smoothing of the occlusal surface using the medium grits (blue) for pre-polishing, then the fine grits for high shine (pink) without high pressure for final polishing. Speed: 10,000-15,000 rpm.

the finish line using a permanent marker (Sharpie Fine Point, Writing Implements, Atlanta, GA, USA) to serve as a reference for the surface evaluation measurements. All specimens were fabricated and prepared by the same investigator.

Surface Evaluation

The surface topography of the central areas of the facial surface of the maxillary right central incisor crowns fabricated out of lithium disilicate and virgilite (CEREC Tessera, Dentsply Sirona) was measured by surface roughness (Ra) and the root mean square roughness (Rq) in nanometers with an atomic force microscope (AFM; Veeco D3100 Atomic Force Microscope; Veeco Instruments Inc, Plainview, NY, USA). A silicone jig was fabricated using heavy body vinylpolysiloxane (VPS) impression material (EXA Advanced, Fast Set Heavy Body, GC America, Alsip, IL, USA) with the specimens parallel to the platform of the atomic force microscope. Subsequently, the probe of the atomic force microscope was positioned within 1 mm mesial from the marking in the labial surface and 25 μm x 25 μm scans were obtained using the contact mode of the microscope (Figure 1). The resulting data was processed with Gwyddion 2.61 (Department of Nanometrology, Czech Metrology Institute, Brno, Czech Republic) and the 3D surface topography was created. Additionally, 3D micrographs were also exported for qualitative analysis.

Visual Assessment

The milled chairside CAD/CAM lithium disilicate and virgilite maxillary right central incisor crowns were visually assessed by 10 dental faculty and 10 dental students. The evaluators were chosen randomly, consented, and were not informed about the different treatments provided to the restorations. Specimens were evaluated under identical lighting conditions.

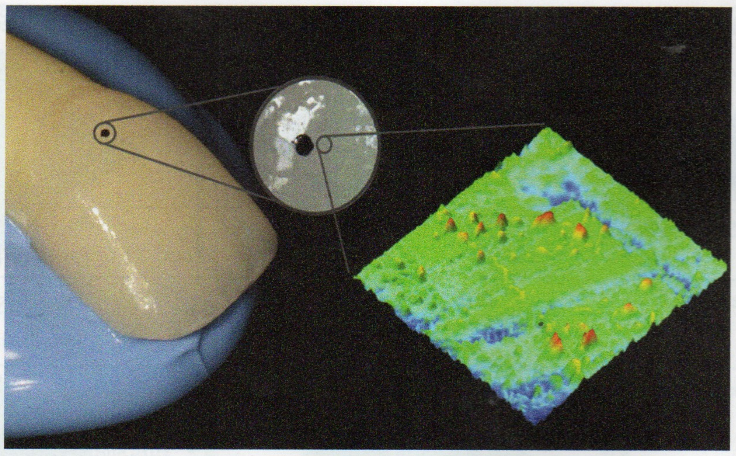

Figure 1. *Schematic showing the prepared samples, a Sharpie mark indicating where the AFM scanning took place, and a representative AFM micrograph. Abbreviations: AFM, atomic force microscope.*

Each evaluator was asked to determine if the group of crowns was either the highest polish, clinically acceptable, clinically unacceptable, or not polished in comparison to other groups. Each evaluator could select only one option. Faculty were general dentists in a clinical track appointment working in the Restorative Dentistry Section and students were third-year clinical students (out of four total years).

Statistical Analysis

The sample size calculation by G*Power (power=0.80) indicated that 6.5-23.3 specimens were needed for each group; therefore 10 specimens/group were used. A two-way analysis of variance (ANOVA) and Tukey's post-hoc test were used for Ra and Rq data, separately. A p-value of <0.05 was considered statistically significant.

RESULTS

Surface Roughness with AFM

The surface roughness (Ra) and root mean square roughness (Rq) mean values and standard deviation and ANOVA analysis, obtained from AFM, are presented in Table 2. Group 5 (DiZR) crowns glazed and polished with Dialite ZR Zirconia (Brasseler USA) (Ra: 26.73 nm; Rq: 37.05 nm) and group 6 (LuZR) crowns glazed and polished with Luster Zirconia (Meisinger USA) (Ra: 34.95 nm; Rq: 45.00 nm) were the most polished groups, following by group 2 (GZ) crowns only glazed (Ra: 42.49 nm; Rq: 52.57 nm) and group 4 (LuLD) crowns glazed and polished with Luster Lithium Disilicate Meisinger USA (Ra: 40.83 nm; Rq: 54.49 nm), followed by group 3 (DiLD) crowns glazed and polished with Dialite LD Lithium Disilicate (Brasseler USA) (Ra: 50.43 nm; Rq: 67.58 nm). The control group 1 (NoG/P) with no glaze and polishing treatment provided the roughest surface (Ra: 1174 nm; Rq: 1298 nm).

The two-way ANOVA revealed that there was a significant influence from the polishing kit and glazing and their interaction with the material for both Ra and Rq, separately ($p<0.0001$). Post-hoc analysis showed that while all polishers and glazing differed from the control group 1 ($p<0.05$), there were no differences in Ra between polishers ($p>0.05$). For Rq, again, all polisher and glazing groups were significantly lower than the control ($p<0.05$), but significant differences existed between polishers ($p<0.05$). Group 5 (DiZR) was significantly lower than other groups ($p<0.05$).

Three-Dimensional Topographic Observations

AFM micrographs of chairside CAD/CAM lithium disilicate and virgilite crowns with different treatments are shown in Figure 2. Each micrograph displays a color height scale bar. Group 1 (NoG/P) showed a rough surface with relatively large topographic features compared to all other groups. On the other hand, Group 2 (GZ) showed many peaks in the range of 500 nm height compared to group 3 (DiLD), group 4 (LuLD), group 5 (DiZR), and group 6 (LuZR).

Visual Assessment

The results of dental faculty and students visually assessing the chairside CAD/CAM lithium disilicate and virgilite maxillary right central incisor crowns are shown in Table 3. All evaluators selected group 1 (NoG/P) as the crown with no polish treatment provided and selected group 2 (GZ) as the crown with

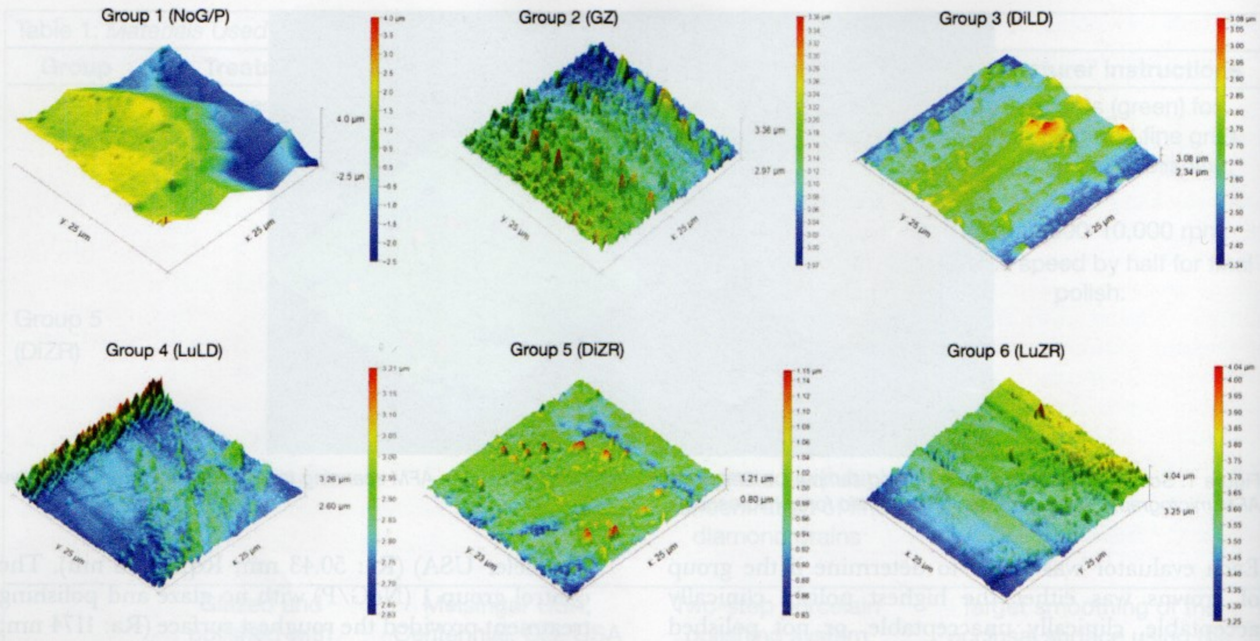

Figure 2. Three-dimensional micrographs of chairside CAD/CAM lithium disilicate and virgilite maxillary right central incisor crowns with different treatments. Group 1 (NoG/P) crowns with no polish/glaze treatment; group 2 (GZ) crowns with glaze treatment; group 3 (DiLD) crowns glazed and polished with Dialite Lithium Disilicate Brasseler USA; group 4 (LuLD) crowns glazed and polished Luster Lithium Disilicate Meisinger USA; group 5 (DiZR) crowns glazed and polished with Dialite Zirconia Brasseler USA; and group 6 (LuZR) crowns glazed and polished with Luster Zirconia Meisinger USA. Scale bars are indicated by the colored bar for each micrograph.

the highest clinically acceptable. On the other hand, group 3 (DiLD) and group 6 (LuZR) were infrequently selected as clinically acceptable.

DISCUSSION

This study compared the effect of glazing alone, two zirconia, and two lithium disilicate polishing systems (and no treatment) on a novel CAD/CAM lithium disilicate and virgilite ceramic. Mean roughness (Ra), root mean square roughness (Rq), and 3D AFM micrographs were used to evaluate the surface roughness. Mean roughness (Ra) is determined by measuring the average of surface heights and depths across the surface and it is one of the most common parameters used for surface finish evaluation. Root means square roughness (Rq) is also used to measure the peaks and valleys and is sensitive to height deviations from the mean line.[22] The glazing and all polishing systems tested in this study increased smoothness in comparison to no treatment. Thus, the first null hypothesis, that glazing and all polishing systems provide a smoother surface than non-polished crowns, was accepted. It is generally recommended to either glaze or polish restorations after milling the restoration.[23] Our results agree with a recent study comparing two ceramic and two composite polishing systems for traditional lithium disilicate e.max CAD that concluded all systems significantly improved the smoothness in comparison to the non-polished group.[24] Moreover, a review evaluating glazed and unglazed all-porcelain crowns concluded that glazed treatment provides a smoother surface than unglazed restorations.[25]

Glazing and polishing systems provided different degrees of surface roughness. Group 5 (DiZR) crowns glazed and polished with Dialite ZR Zirconia (Brasseler USA) provided the smoothest surface, followed by group 6 (LuZR) crowns glazed and polished with Luster Zirconia (Meisinger USA), then group 2 (GZ) crowns only glazed, group 4 (LuLD) crowns glazed and polished with Luster Lithium Disilicate (Meisinger USA), and group 3 (DiLD) crowns glazed and polished with Dialite LD Lithium Disilicate (Brasseler USA). The control group 1 (NoG/P) crowns with no glaze and polish treatment provided the roughest surface. Therefore, the second null hypothesis was partially rejected because group 5 (DiZR) showed significant differences in Rq compared to other polishing systems. The literature evaluating glazing versus polishing is generally controversial because studies are showing superior results for both approaches. A previous investigation compared different methods of glazing and

Table 2: *Results Comparing Glazing and Different Polishing Systems for Chairside CAD/CAM Zirconia-Reinforced Lithium Disilicate Crowns*[a]

Group	Factor	
	Mean Roughness Ra (nm)	Root Mean Square Roughness Rq (nm)
Group 1 (NoG/P) No Glazed/Polished	1174 (±87.71) a	1298 (±82.51) a
Group 2 (GZ) Glazed without polished	42.49 (±4.13) b	52.57 (±5.32) b
Group 3 (DiLD) Glazed and polished with Dialite LD Lithium Disilicate	50.43 (±7.89) b	67.58 (±6.74) b
Group 4 (LuLD) Glazed and polished with Luster Lithium Disilicate	40.83 (±6.94) b	54.49 (±5.35) b
Group 5 (DiZR) Glazed and polished with Dialite ZR Zirconia	26.73 (±5.67) b	37.05 (±8.38) c
Group 6 (LuZR) Glazed and polished with Luster Zirconia	34.95 (±8.06) b	45.00 (±9.50) b

[a] *Dissimilar letter indicates statistical significance difference between groups for each factor, as described in the Materials and Methods section. Mean roughness, Ra, and root mean square roughness, Rq, were analyzed separately.*

Table 3: *Visual Assessment for Highest Polish, Clinically Acceptable, Clinically Unacceptable, and Not Polished by Dental Students and Faculty Members (Total of 20)*

Group	Highest Polish	Clinically Acceptable	Clinically Unacceptable	No Polish Provided
Group 1 (NoG/P)	—	—		20/20
Group 2 (GZ)	19/20	1/20		
Group 3 (DiLD)	—	7/20	13/20	
Group 4 (LuLD)	1/20	19/20	—	—
Group 5 (DiZR)	—	20/20	—	—
Group 6 (LuZR)	—	13/20	7/20	—

Abbreviations: NoG/P, No polish/glaze; GZ, glazed; DiLD; Dialite Lithium Disilicate Brasseler USA; LuLD, Luster Lithium Disilicate Meisinger USA; DiZR, Dialite Zirconia Brasseler USA; LuZR, Luster Zirconia Meisinger USA.

polishing treatments on lithium disilicate and zirconia ceramics and demonstrated that glaze powder/liquid after crystallization is the most effective way to reduce the surface roughness of lithium disilicate ceramics while mechanical polishing after crystallization is best for zirconia-reinforced silicate ceramics.[26] Another *in vitro* study evaluated five common ceramic polishing systems on lithium disilicate surfaces and found that none of the polishing kits used could create a surface smoother than glazed ceramic.[27] However, in another study, investigators measured the surface roughness of milled chairside CAD/CAM restorations using several polishing systems on a nano-ceramic, hybrid ceramic, and leucite-reinforced ceramic and showed it is possible to create an equally smooth surface among the materials and polishing systems tested. They also showed that polished ceramic surfaces were generally smoother than glazed ceramic surfaces.[28] Our investigation agreed with the previous mixed findings because the group 2 (GZ) crowns glazed without polish treatment provided a smoother surface than group 3 (DiLD) crowns with glazed and polished with Dialite Lithium Disilicate (Brasseler USA), but rougher than group 4 (LuLD) crowns glazed and polished with Luster Lithium Disilicate (Meisinger USA).

The findings also revealed that zirconia polishing systems created a smoother surface than lithium disilicate systems. Thus, the null hypothesis that there is no difference between lithium disilicate and zirconia polishing systems was rejected. These findings agree with a recent study that compared three zirconia polishing kits, one ceramic kit, and a control group with no polishing treatment for zirconia ceramic. This study concluded all zirconia polishing systems created smoother surfaces than porcelain kits and the unpolished group.[29] Another study evaluated the surface roughness of two zirconia and one feldspathic porcelain ceramic after being treated with two zirconia and one porcelain polishing system. The results indicated that zirconia polishing systems could create a smoother surface than traditional feldspathic polishing systems.[30] A possible reason for the improved polishing achieved with zirconia polishers can be associated with the concentration of diamond grains and the mechanical properties provided by the binder used by the manufacturer. In the present study, the specimens in group 5 displayed the lowest Ra values and were deemed clinically acceptable when visually assessed by all the participants of the study (20/20). The abrasive system used in this group consisted of two points made of polyethylene impregnated with highly concentrated medium and fine grit diamond grains. It is possible the high resistance and favorable flexibility of the polyethylene binder enhanced the abrasiveness of the diamond grains by preventing their dislodgement. Additionally, this binder may permit using higher RPM hence increasing the number of times viable diamond grains contact the surface of the specimens. Other factors such as the concentration, quality, and grit size of the diamond grains possibly played a role, however, details on these aspects are not commonly disclosed by the manufacturers hence impeding objectively associating their effect with the results of this study.

The findings of the visual assessment by dental faculty and students agreed with the AFM findings in which the control group 1 (NoG/P) crowns provided the roughest restorations and were deemed as not clinically acceptable. These findings agreed with other visual assessment studies; first, a previous study visually assessed CAD/CAM provisional materials crowns fabricated with 3 different materials and with no polish and polished with three different systems. This study found that clinicians and students identified the non-polished crowns as not clinically acceptable.[31] Another visual assessment study by senior dental students and faculty members evaluated crowns fabricated with polymer-infiltrated ceramic unpolished and polished with five different polishing kits. These findings are by their nature subjective and may differ between clinicians. Their results indicated that the non-polished restorations were clinically unacceptable.[32]

It has been recommended to polish ceramic restorations after fabrication to minimize the risk of degradation, prevent biofilm and stain accumulation, avoid gingival inflammation, and decrease the wear to the opposing dentition.[33-35] Furthermore, worn restorations due to adjustments are recommended to be polished to reduce superficial staining that causes color changes.[36-38] A recent study evaluating the effect of surface treatment on the optical, shade, and surface characteristics of lithium disilicate was conducted and the study treated the ceramic speciemens with diamond burs for grinding, polishing systems, and glazing. The surface was evaluated with profilometer, electron microscopy images, and spectrophotometer. The results indicated that grinding the ceramic deteriorated the optical, colorimetric, and surface characteristics of the ceramic while polishing reduced its roughness and enhanced the translucency. However, glazing reduced the roughness but reduced the translucency, and therefore polishing treatment is recommended after grinding.[39] Another recent study also assessed the effect of coffee beverage and whitening systems on the surface roughness of lithium disilicate. This study tested the surface roughness and gloss with a profilometer and glossmeter after samples were immersed for 24 hours for 12 days in coffee and whitening protocol for 2 minutes twice daily for 7 days and the results revealed that all samples had a significant increase in surface roughness after being subjected to coffee and whitening systems.[40]

The novel lithium disilicate and virgilite ceramic was recently released to the market. This chairside CAD/CAM ceramic has a composition of 90% lithium disilicate crystals, 5% lithium phosphate, and 5% virgilite crystals which are less than 100 nanometers.[20] Initial independent studies have shown promising results regarding its mechanical properties.[41-43] These studies show that the novel lithium disilicate has a similar fracture force as IPS e.max. Moreover, clinical reports have also demonstrated good outcomes with fast fabrication and accurate fitting of the prosthesis.[44] Unfortunately, there is a lack of data evaluating its polishability and the manufacturer does not fabricate its specific polishing system nor recommend a specific system for treating it. Therefore, this *in vitro* study provides the first data comparing systems for this ceramic.

The effectiveness of two widely utilized lithium disilicate and two zirconia polishing systems were compared in this study. However, despite their popularity, these kits only cover a small portion of the polishing systems available in the market. Therefore, further investigations are required to compare more brands to determine what is the best option to polish the novel ceramic material assessed in the present study. Moreover, we also compared a regular glazing application but it would be interesting to evaluate a second glazing application to create overglazing. It may also be interesting to have *in vitro* investigation of the glazed and polished restoration after chewing simulation and evaluate their lasting efficacy.

CONCLUSIONS

Glazing followed by zirconia and lithium disilicate polishing considerably reduced the surface roughness for chairside CAD/CAM lithium disilicate and virgilite crowns. Altogether, zirconia polishing systems provided a smoother and more clinically acceptable surface than the lithium disilicate kits. However, even within zirconia polishing systems, differences existed between brands, specifically with DiZR showing lower roughness values than other zirconia polishing groups. Our results imply clinicians should select the polishing kit carefully to ensure optimum surface smoothness.

Conflict of Interest

The authors of this article certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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