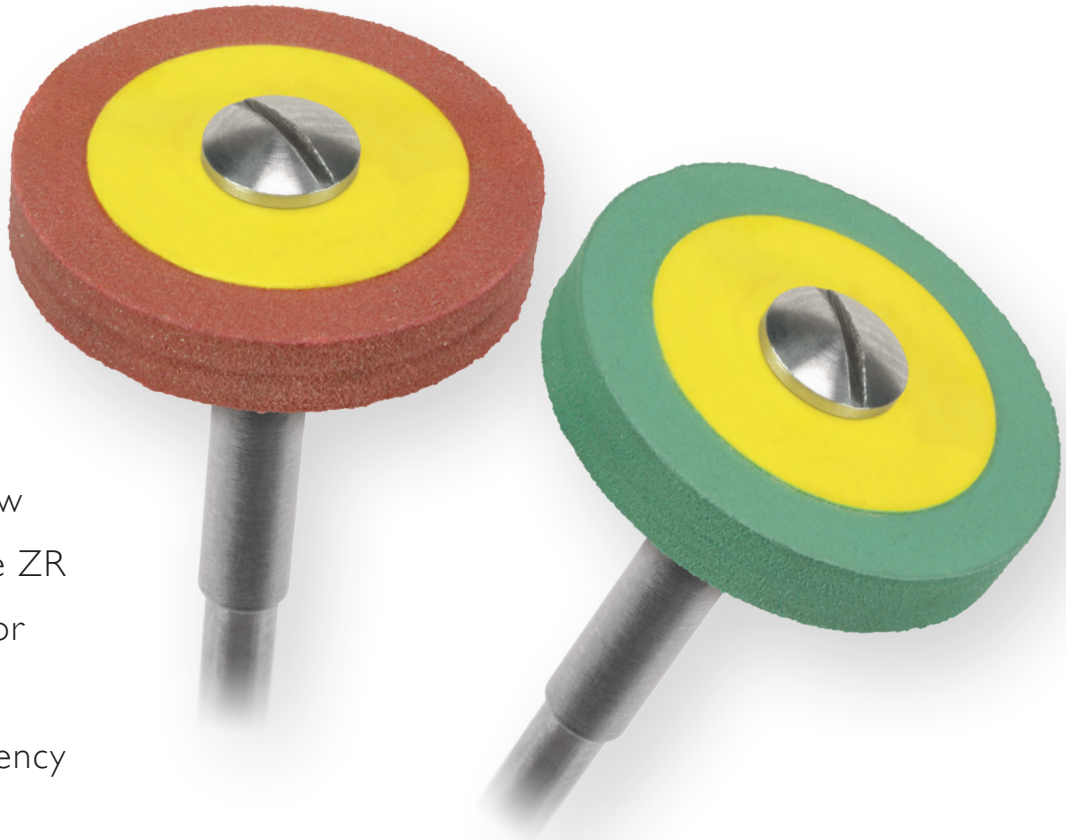
Technique Guide:

FINISHING & POLISHING OF MODERN DENTAL CERAMICS

Lithium Disilicate & Zirconia

According to John A Sorensen, DMD, PhD



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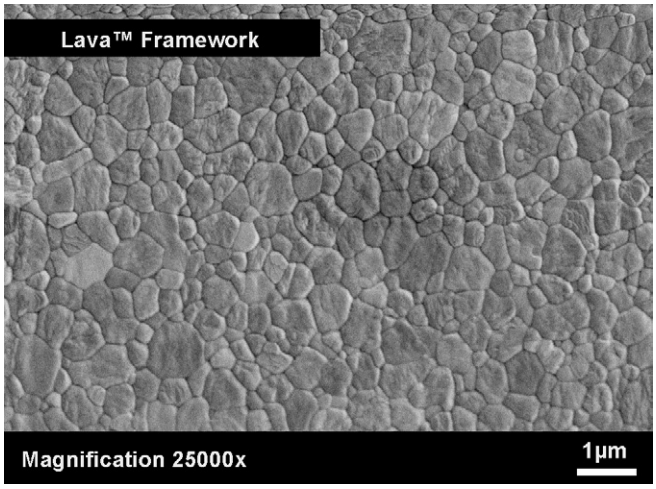
Dialite® ZR Zirconium Oxide

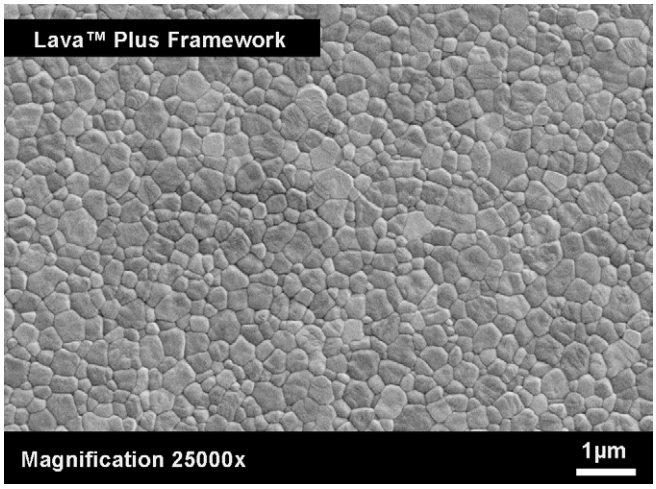
Dental zirconium oxide (ZrO_2) ceramics have a very high polycrystalline content which has a small amount of Yttria added to maintain the ZrO_2 in the tetragonal phase conferring the ability to undergo transformation toughening making it the strongest dental ceramic available. This metastable state can be transformed back to the monoclinic phase if overheated with temperature spikes while adjusting. However, the fusion temperature of ZrO_2 is quite high making the ceramic more abuse resistant than other dental ceramics. Additionally, although ZrO_2 is extremely strong, if traumatized during fabrication and adjustment with a coarse diamond, excessive pressure with a handpiece or heat generation can cause phase shift or induction of flaws which can lead to propagation of cracks and even failure.

A clinical problem associated with ZrO_2 restorations especially in the early years was chipping of the veneering porcelain. A popular new design concept has been to eliminate the veneering porcelain and mill full-contour crowns entirely out of ZrO_2. This eliminates the possibility of chipping and produces a nearly bullet-proof restoration even on second molars in bruxers.

Zirconium oxide restorations have become extremely popular with many major companies like Lava™ (3M ESPE®), e.max® ZirCAD (Ivoclar Vivadent®), Zenotec® (Wieland Dental), Cercon® (DENTSPLY International), Prettau® (Zirkonzahn®) and a myriad of smaller companies making CAD/CAM fabrication systems. Prevalent trade names of full contour monolithic ZrO_2 restorations include Lava™ Plus (3M ESPE®), BruxZir® (Glidewell Laboratories), Zir-MAX® (Burbank Dental Laboratory), Cercon® ht (DENTSPLY International), Diazir™ (Diadem Precision Technology) just to name a few. While the quality, homogeneity, flaw content and particle size of the ZrO_2 may vary between manufacturers' systems, they all possess superior polishing qualities.



SEM of polycrystalline structure of Lava™ Framework ZrO_2 (mean particle size about 0.6 µm).



SEM of the new more translucent Lava™ Plus ZrO_2 (about 0.3 µm particle size).

These SEM pictures show the polycrystalline structure of Lava™ Framework ZrO_2 (mean particle size of about 0.6 um) and the new more translucent Lava™ Plus zirconia (0.3 um particle size). This fine particle size compared to dental porcelains at 3-5 um mean particle size, make ZrO_2 the most machinable and highly polishable ceramic material available in dentistry. This photo *(right)* demonstrates how the exposed polished ZrO_2 on the lingual cusp of the second molar is actually smoother than the polished veneering porcelain.

Microscopic surface roughness of a ceramic restoration is the key property in controlling wear of antagonist tooth structure. Therefore, another advantage of highly polished full contour ZrO_2 crowns is the minimal wear of opposing tooth structure.

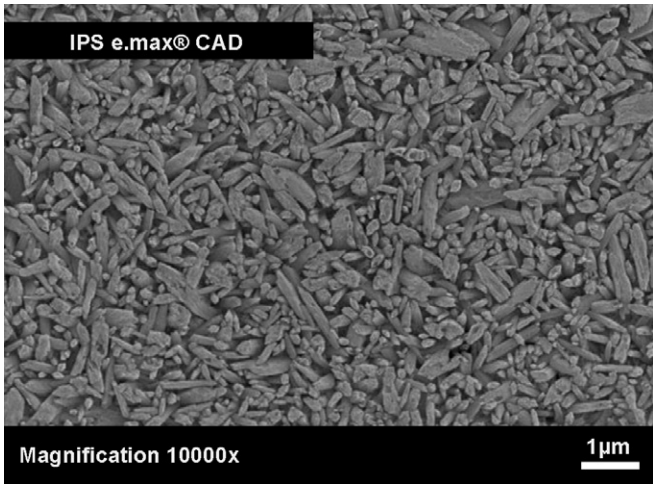
With new high translucency zirconias like Lava™ Plus and the ability to differentially color a full contour ZrO_2 crown with incisal, body and dentin shades, extremely esthetic restorations can be produced.

Exposed polished ZrO_2 substructure at lingual cusp of 2nd molar. Note how zirconia is polished to higher luster than veneering porcelain.

THE SCIENCE ON MODERN DENTAL CERAMICS...

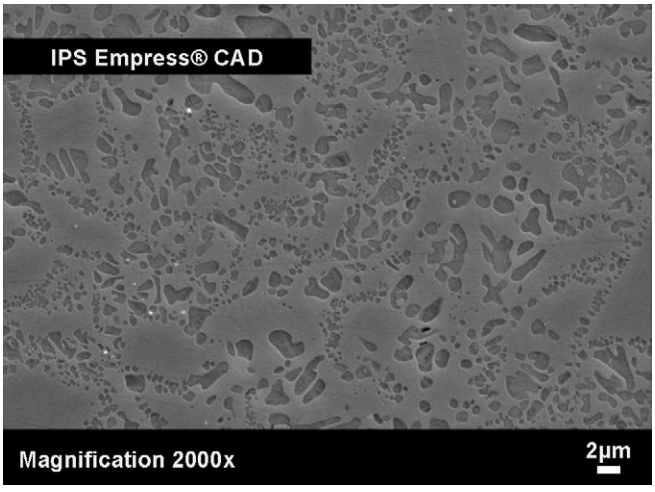
Dialite® LD Lithium Disilicate Glass Ceramic

Depending on the demands of the clinical situation, the e.max® system from Ivoclar Vivadent® has a variety of fabrication technologies to produce lithium disilicate (LS_2) high strength restorations either at chair-side or in the laboratory. e.max® CAD starts as a semi-sintered block which is easily milled in the CEREC® (Sirona®) or E4D® (D4D®) systems. Once milled, the restoration is fired in an oven to attain maximum strength with no net shape change to produce accurately fitting restorations. The LS_2 form can be used as a substructure for application of veneer porcelain or milled to full contour. The inherent translucency of the ceramic produces a highly esthetic restoration eliminating the need for veneering on most posterior teeth. The e.max® Press system fabricates a crown by waxing to desired contours, investing and then hot pressing the LS_2 into the mold. The e.max® Press form can also be made as a substructure or pressed to full contour. The innovative e.max® CAD-on system utilizes CAD/CAM technology to mill a high strength LS_2 veneer for zirconia substructures.



SEM of IPS e.max® CAD lithium disilicate. The high crystalline content (~70%) incorporated in a glass matrix produces a high strength ceramic without compromising translucency.

The e.max® LS_2 system has great durability with a flexural strength of 360-400 MPa. When fabricated to full-contour, the monolithic structure is one of the most robust ceramic systems available. Adding to the clinical applications, even in reduced thickness situations the e.max® LS_2 has been shown to perform well. With the outstanding esthetics conferred by the LS_2 microstructure even as a monolithic crown this system is an excellent option for routine restoration of posterior teeth whether fabricated by chair-side milling or laboratory technician. For most chair-side fabricated restorations no porcelain oven glazing or staining is necessary. By merely using the Dialite LD polishing system an extraordinary quality finish and polish can be rapidly achieved that rivals the polish of any glazed or polished indirect restorative system available in dentistry.

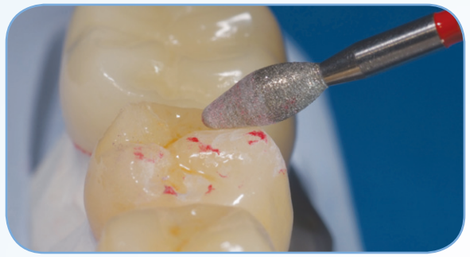


SEM of IPS Empress® CAD milling block with a leucite crystal content of 35 to 45 vol % with crystalline size of 1-5 µm.

Clinical trials have reported high clinical success rates for molar LS_2 crowns. Additionally, in vitro oral wear simulator studies show wear of antagonist enamel tooth structure from LS_2 to be similar to a gold platinum alloy or an enamel control. If the clinician wished to use this material for second molars in bruxers then longevity can be maximized by making a monolithic crown with no veneering.

Not to be forgotten is the Empress® CAD system. Although the leucite glass ceramic is not as strong as the LS_2 ceramic it is well suited for chair-side CAD/CAM production of crowns that only require polishing with Dialite LD polishing kit. With adhesive cementation these restorations have established a long history of high clinical success rates. Improving further on this concept, Ivoclar Vivadent® developed the Empress® CAD Multi Block which is comprised of four to eight layers of chroma, translucency and transitions that beautifully simulate the different layers of a natural tooth producing an extremely esthetic restoration also requiring only polishing after chair-side milling.

LITHIUM DISILICATE POLISHING



Representation of intra-oral occlusal adjustment of LD2 with new red-band fine Dialite finishing diamond 8369DF.

Representation of intra-oral occlusal adjustment of LD2 with new yellow-band extra-fine Dialite finishing diamond 369DEF.

Dialite LD red medium thin polishing disc L20MLD for polishing grooves.

Dialite LD red medium polishing point H2MLD for crafting a shine in the occlusal grooves.

Representation of intra-oral polishing of LD2 with intra-oral red medium polishing Dialite LD point W16MLD.

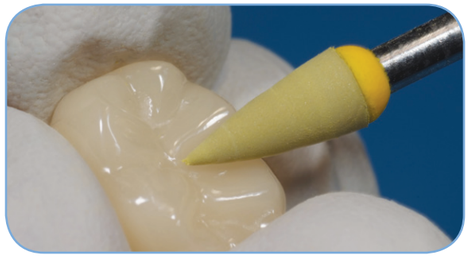
Representation of intra-oral fine polishing of LD2 with intra-oral yellow fine polishing Dialite LD point W16FLD.

Dialite LD yellow fine polishing wheel R17FLD for establishing high shine and luster on lithium disilicate (note right side with finish polish).

Dialite LD yellow fine thin polishing disc L20FLD for polishing grooves.

Completely polished LD2 crown with no stain or glaze.

Grinding off positioning sprue with LD Grinder LD13M, which minimizes heat generation.



Dialite LD yellow fine polishing point H2FLD for creating a shine in the occlusal grooves.

Completed lithium disilicate crown only polished with Dialite LD kit and no stain or glaze.

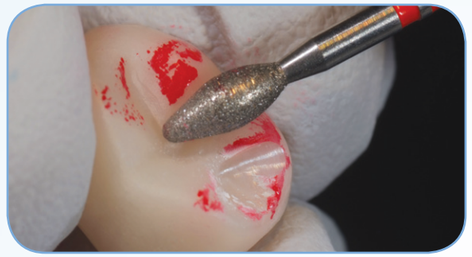
Devested IPS e.max® Press LD crown. Because occlusion can be precisely waxed there is no need to grind-in anatomy. Only polishing is necessary.

Dialite LD red medium polishing wheel R17MLD for establishing shine on lithium disilicate (note right side polished and left side untreated blasted surface).

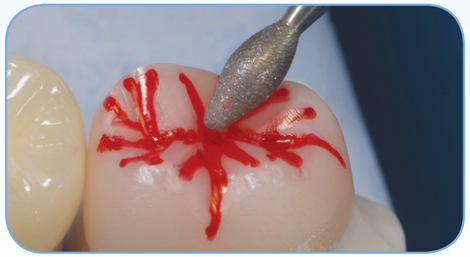
Comparison of LD stain and glazed premolar crowns, Dialite LD kit polished LD 1st molar crown and Dialite ZR polished ZrO_2 2nd molar crown (lingual view).

Comparison of 1st premolar stained and glazed, 2nd premolar and 1st molar polished only. Dialite ZR polished ZrO_2 2nd molar crown (buccal view).

ZIRCONIA POLISHING



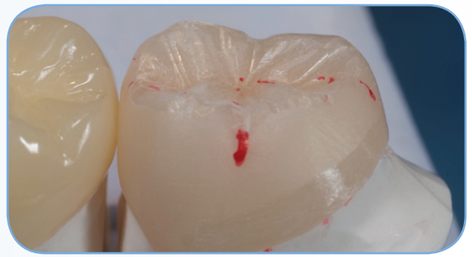
Adjustment of occlusion on full contour ZrO_2 crown using football-shaped red-band Dialite finishing diamond 8369DF.



Grinding in anatomy of ZrO_2 crown using football-shaped red-band Dialite finishing diamond 8369DF.

Dialite ZR orange fine polishing point H2FZR for high shine in the occlusal grooves.

Dialite ZR orange fine thin polishing disc L20FZR for high shine in grooves.



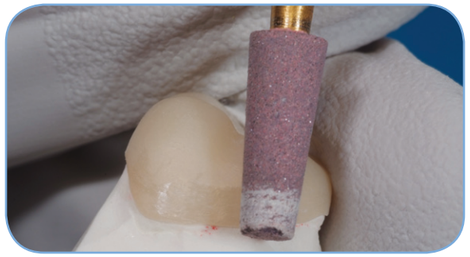
Primary and secondary anatomy ground in full contour ZrO_2 crown.

Small round red-band Dialite finishing diamond 8801LDF grinding in grooves and refining secondary anatomy in ZrO_2.

Completed polished full contour ZrO_2 crown.

Completed full contour ZrO_2 crown #18 and lithium disilicate crowns #19 and #20 with durable high shine and luster (occlusal view).

Gross contouring of full ZrO_2 crown with green coarse LD Grinder LD13C.



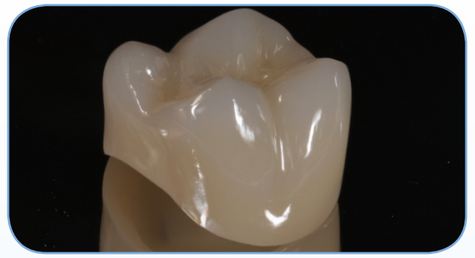
Refining adjustment of full ZrO_2 crown with pink medium LD Grinder LD13M,

Completed full contour ZrO_2 crown #18 and lithium disilicate crowns #19 and #20 with durable high shine and luster (buccal view).

The new Lava™ Plus All-Zirconia Monolithic system achieves esthetic results that match the VITA™ Shade Guide.

Dialite ZR green medium polishing wheel R17MZR for establishing shine on ZrO_2 (note right side with high polish even with Medium Fine polishing only).

Dialite ZR green medium polishing point H2MZR for crafting a shine in the occlusal grooves.



Lava™ Plus monolithic translucent ZrO_2 crown differentially colored with incisal and dentin internally, then polished with Dialite ZR system (buccal view).

Lava™ Plus monolithic translucent ZrO_2 crown polished with Dialite ZR system (palatal view).

Photos and content courtesy of Dr. John A. Sorensen, DMD, PhD

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