

CEREC[®] ZIRCONIA

Chairside Restorations
in a Single Visit

CEREC Zirconia: An Overview

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Chairside Full-contour Zirconia Restorations

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Dear Friends:

Thank you for reading this special digital supplement of *cerecdoctors.com* magazine focusing on the new zirconia solution by Dentsply Sirona. Our aim is to provide you with an overview of the entire process of fabricating zirconia restorations chairside with the CEREC system.

For more detailed information, please visit www.cerectoctors.com/oven where you can watch videos on each step of the process of fabricating zirconia with the CEREC system. The video series is intended to guide all users on techniques, protocols and required equipment.

The ability to fabricate zirconia with CEREC in a single appointment is certainly an exciting advancement for CEREC users, and therefore, we will be including this workflow in our upcoming seminar, [Treating Comprehensive and Esthetic Cases With a Digital Workflow](#).

As always, cerectoctors.com remains at the forefront of providing the most current information to all CEREC users. With our team of clinicians and contributors, and our strong partnership with Dentsply Sirona, you can be sure that we are committed to keeping CEREC users engaged and informed on all things CEREC.

Thank you for helping to make cerectoctors.com the world leader in CEREC education and information. We look forward to seeing you at an upcoming seminar or hands-on workshop.

Sameer Puri, D.D.S.
Founder, cerectoctors.com



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Chairside Zirconia Is Here

Clinical Flexibility and Predictability for CEREC Dentists



FULL-CONTOUR ZIRCONIA HAS EMERGED AS ONE OF THE MOST POPULAR RESTORATIVE MATERIALS IN THE LAST FEW YEARS.

The increased use of this material by dentists worldwide is a result of many restorative advantages: extremely high flexural strength, allows more conservative preparation of teeth, allows a lower minimal thickness than other ceramic materials, great performance in patients with parafunctional habits, ability to conventionally cement, and of course it's tooth-colored.

In the past, the main disadvantage for dentists, specifically those who do CAD/CAM single-visit restorations, is fabrication time. Full-contour zirconia needs to be sintered, a process that traditionally takes multiple hours to accomplish. This would force a dentist to buy an additional furnace or send to a dental laboratory to fabricate the restoration. Most importantly, it was not a single-visit procedure.

This has now changed.

At the 2016 Chicago Midwinter Meeting, Sirona introduced a revolutionary new zirconia workflow that will allow dentists to fabricate full-contour zirconia in a single visit. Most importantly, the workflow only takes about an hour and a half! To accomplish this, Sirona has introduced dry milling capabilities with their

CASE STUDY

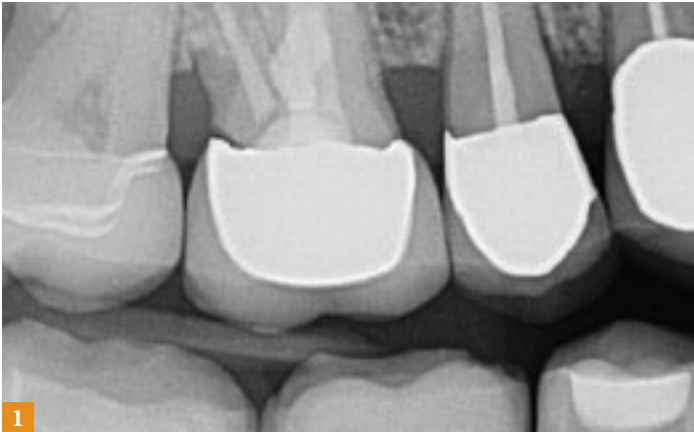
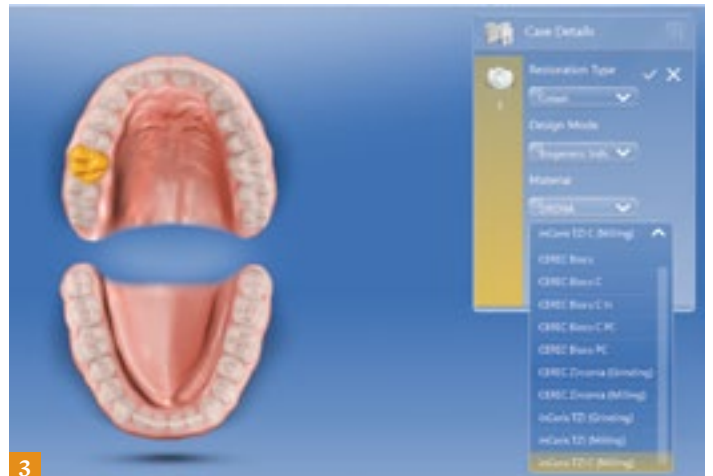


FIG. 1: This patient presented to my office with a PFM and RCT tooth that had a defective subgingival margin on the distal. We decided that the restoration needed to be replaced.



FIG. 2: After removing decay and final preparation of the case, it was determined that the best restorative option would be a cementable zirconia crown. This was due to the fact that the preparation did not have any enamel left and was very subgingival on the mesial, distal, and lingual. The material that was chosen was Sirona inCoris TZI C, shade A1.

FIG. 3: In Administration Phase of the software, the material (TZI C) was chosen to be milled "Dry" in the new Sirona Wet/Dry milling unit



milling units and a brand new furnace called the “CEREC SpeedFire.” In this article, I will review the workflow in detail with a clinical case. But first, let me describe the two features that are important, the milling and the new furnace:

- **MILLING:** The MC X and MC XL Practice Lab milling units now have the option for dry milling capabilities. What this means is that it can mill all the traditional materials that CEREC offers in a “wet environment” (the same as it has always done). It also has the ability to mill zirconia in a “dry environment” with the aid of a new evacuation unit that is attached to the milling unit. Milling zirconia dry has advantages when it comes to sintering time (it doesn’t have to be dried, which lowers the firing cycle). This will be described below. It should be noted that all the current wet milling units can mill (carbides) or grind (diamonds) zirconia in a wet environment. Current users will NOT have to buy a new milling unit to participate in the new workflow.

Milling or Grinding in a wet environment will only add 10 to 12 minutes to the sintering time (additional drying cycle).

- **CEREC SPEEDFIRE:** The “magic” of the entire process is the new furnace. A revolutionary accomplishment that allows you to not only speed-sinter zirconia, but also run a stain/glaze cycle. You read that right... a single furnace for both sintering and glazing restorations! If you mill zirconia dry, the sintering time is only about 15 minutes; if you mill/grind wet, the process is about 27 minutes. After you sinter the restoration, the glazing process (including cooling) is only about 7:30. Another great feature of the CEREC SpeedFire is its incredibly small footprint. It can be set on any table or countertop like any other oven. To top it all off, it communicates wirelessly with the CEREC software as a device. Based on what you are doing, the CEREC software automatically transfers the proper cycle to the oven after the restoration is milled!

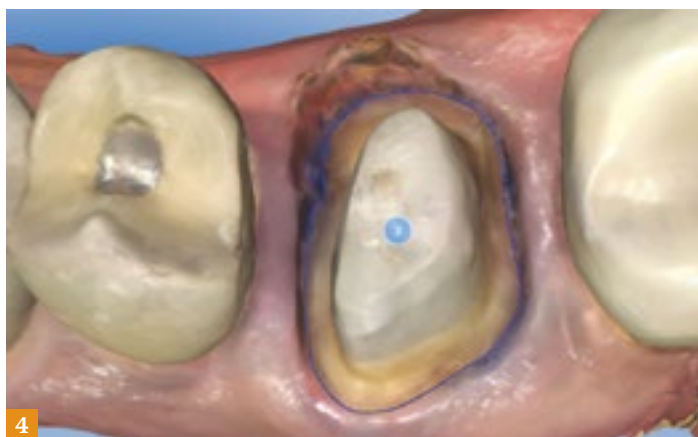


FIG. 4: The preparation was margined in the 4.4.1 software.

Note that a deep chamfer margin design was used, the lack of enamel, and how subgingival the margins are, reinforcing the decision for a cementable restoration.

FIG. 5: Initial Biogeneric proposal. Note the excellent anatomy and the fissure thickness of .91 mm. Two advantages of using zirconia is that it can be milled a little thinner and, because it uses fine finishing carbides and milled roughly 20 percent larger, the milled anatomy will be more defined than traditional CEREC ceramics.

FIG. 6: When you go to the Mill Preview, you will be prompted to choose the final shade of the zirconia restoration. This shade information will have a direct effect on the firing times in the CEREC SpeedFire furnace.

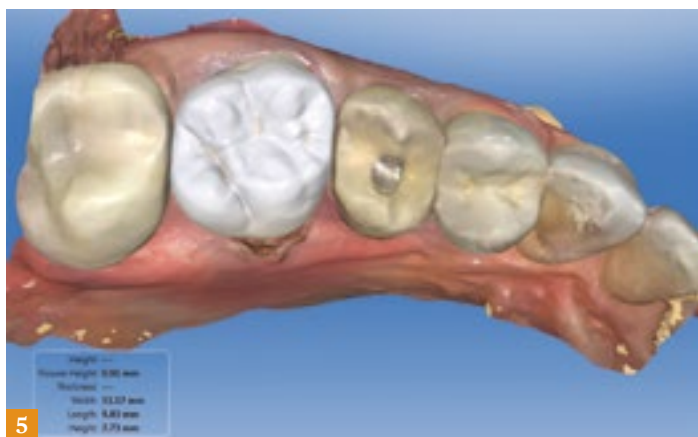


FIG. 7: The mill preview of the restoration. You can see the option to fast mill the zirconia. My experience is that it results in wonderful milled margins. You also can see that the furnace is automatically selected so the software knows to transfer the sintering parameters automatically after the milling process is complete.

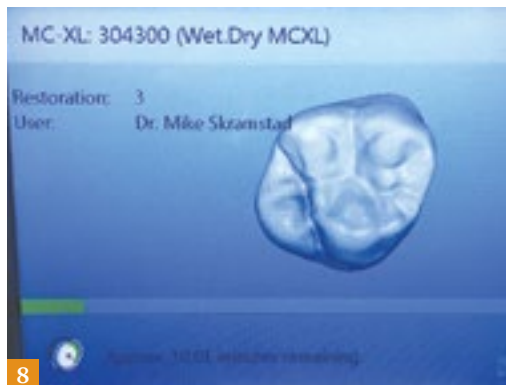


FIG. 8: The time it takes to fast-mill a zirconia restoration is just over 10 minutes — milling approximately as fast as other CEREC ceramic materials

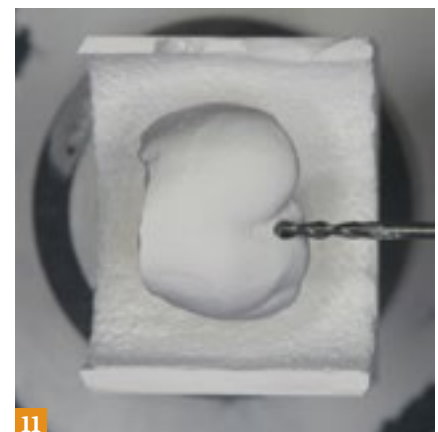
FIG. 9: The inCoris TZI C block ready to be milled by the Shaper 25 and Finisher 10 instruments



FIG. 10: The gross reduction of the TZI C block is removed by the Shaper 25 bur. Note the dry milling of the block.



FIG. 11: After initial gross reduction, the smaller Finisher 10 bur fine-tunes the restoration, producing immaculate fits, occlusion and anatomy



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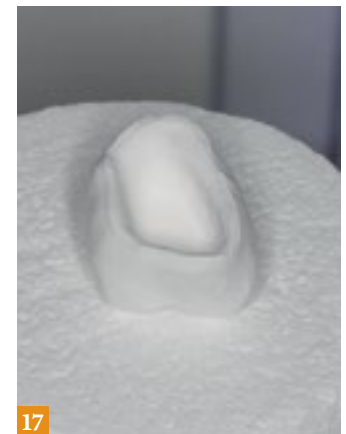
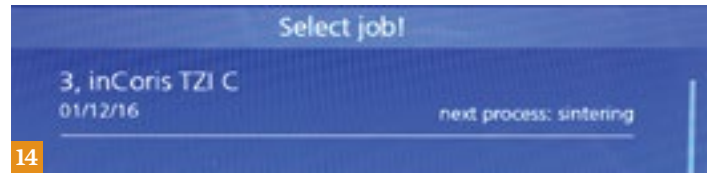
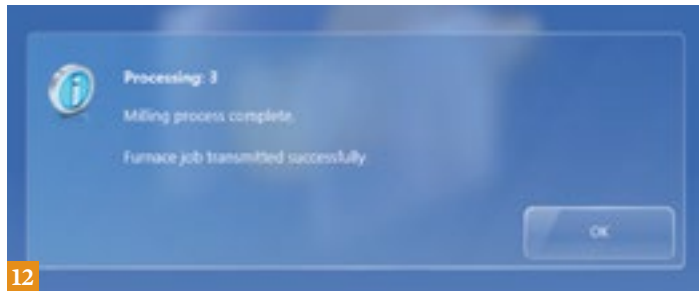


FIG. 12: After the milling is finished, the software prompts you that the furnace job was transferred successfully to the CEREC SpeedFire

FIG. 13: The CEREC SpeedFire. Note the small footprint of the furnace and the touchpad that communicates with the CEREC software. Here it sits on a table next to the milling unit.

FIG. 14: The touchpad shows the job that was transferred to the furnace

FIG. 15: You have the option of sintering the restoration (what you would do if it were milled dry), a separate pre-drying cycle, or a pre-drying and sintering cycle. The last two options would be used if the zirconia was milled/grinded in a wet environment.

FIG. 16: The sprue on the zirconia is removed using a fine rubber wheel. Zirconia in its pre-sintered state is very fragile and care must be taken to carefully remove the sprue and not drop the restoration.

FIG. 17: The restoration is placed in the furnace on the occlusal surface. No sintering beads or other support is necessary when sintering the zirconia.

FIG. 18: The sintering process has begun and only will take just over 15 minutes. This is including a cooling process at the end.

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FIG. 19: After the sintering process is complete, the restoration is placed on a small fan in front of the unit for a minute to finalize the cooling process.



FIG. 20: After the sintering, the furnace will prompt you for the next step. You can glaze the restoration immediately (indicated for same-day restorations), continue the glazing at a later time if you wish (the furnace will remember the job), or finish the job in scenarios in which you are not going to glaze.

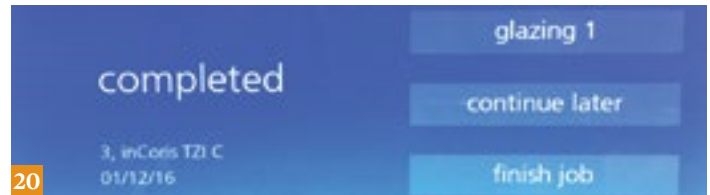


FIG. 21: The restoration was characterized with GC Lustre Paste and spray-glazed with Sirona SpeedGlaze (a new product introduced by Sirona for this workflow). It is advisable that you support the restoration on a firing peg for this step to prevent getting glaze on the inner surface of the restoration.



FIG. 22: The glaze time for this restoration was just under 8 minutes (including cooling time)



FIG. 23: Final cemented TZI C restoration occlusal view. Note the color match and the nice anatomy resulting from the carbide milling.

FIG. 24: Final cemented TZI C restoration, buccal view. Please note how the zirconia restoration blends with the existing arch.



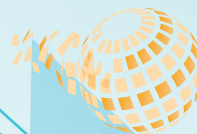
SUMMARY

The ability to fabricate chairside zirconia restorations has many benefits that have been described in this article. The most important is clinical flexibility. This new workflow allows us as CEREC users to expand our clinical environment and treat all patients in a predictable matter. My personal experience with this process has been eye-opening and I have been amazed at the clinical margins and occlusal accuracy.

The restoration in this article was completed in an appointment of 1.5 hours. Who would have ever imagined this possibility?!

NOTE: Please visit www.cerecdotors.com for a new section on this chairside zirconia workflow with both software and live clinical videos.

For questions and more information, Dr. Skramstad can be reached at mike@cerecdotors.com.



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Chairside Full-contour Zirconia Restorations

A Strong, Fracture-resistant Alternative Restorative Material



A RECENT INNOVATION BY DENTSPLY SIRONA HAS INTRODUCED THE FABRICATION AND DELIVERY of full-contour zirconia crowns in a single appointment. This is a great opportunity to review the current status of zirconia as a restorative material and consider how it will complement the existing restorative material options with CEREC.

Zirconia is different from all other chairside CAD/CAM materials in that it is a polycrystalline material that does not contain glass particles. The quality of zirconia is a function of the processing of the raw materials by the manufacturer to minimize porosity, enhance density, and ensure a homogenous material. The crystalline structure of zirconia also has a unique ability to resist crack development.

Zirconia is stabilized to be a tetragonal crystal at room temperature. If a crack is initiated in the zirconia, the energy at the leading edge of the crack causes a phase shift to monoclinic crystals. The crystal phase shift results in a localized volumetric expansion that creates a compressive force on the developing crack, preventing it from propagating. This process is called Transformation Toughening, and is a significant contributor to the high strength of zirconia and its ability to resist chipping and fracture under function.

Early zirconia crowns were veneered with feldspathic porcelain to improve the esthetic appearance of the crown because zirconia is opaque and less translucent than glass containing ceramics. However, the chipping of the veneer porcelain led many dentists to be discouraged with their use. Full-contour zirconia crowns have become preferred due to the simple fact that the surface of a full-contour zirconia crown is resistant to chipping or fracture. This avoids the primary failure mechanism of porcelain veneered zirconia crowns.

Zirconia is generally too hard to mill in the sintered, or processed state. It would be very destructive to milling diamonds as well as result in excessive mill times. Instead, zirconia is machined in a partially fired, or pre-sintered form. Pre-sintered zirconia is easily milled with very good margin fidelity. And a post-milling oven sintering process at very high temperature, ~1,350 C to 1,500 C, is required to fully crystallize the zirconia. The oven sintering process also results in a volumetric shrinkage of zirconia between 20 percent and 25 percent. Manufacturers bar code the zirconia blocks to record the specific shrinkage percentage of the block. The bar code is input to the design software to mathematically expand the design by the block shrinkage factor. The milled restoration is obviously considerably

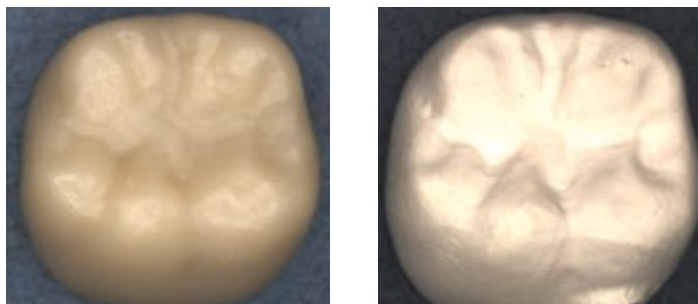
larger than the desired final restoration. It is tempting to perform contour adjustments to the softer, pre-sintered restoration, however, there is a significant risk of damage if it is not done very carefully. The milled restoration shrinks to the correct volumetric form during oven sintering to create the fully crystallized zirconia restoration.

STRENGTH

Strength of ceramics is often measured by either flexural strength or fracture toughness. The veneering porcelain on the surface of PFM crowns has a flexural strength in the range of 90-100 MPa. High-strength ceramics such as lithium disilicate or zirconia-reinforced lithium silicates have flexural strengths in the range of 350-425 MPa with a fracture toughness of 3.2 to 3.5 MPa/m². Zirconia has a flexural strength in excess of 900 MPa and a fracture toughness of 5.5 to 7.4 MPa/m². The strength of the ceramic material is often cited as a critical element in the success of the restoration. Obviously, thickness of the material as a result of appropriate occlusal reduction and adhesive bonding of glass-containing ceramics have shown current CEREC materials as very successful in high-stress posterior restorations. However, zirconia does allow for a thinner occlusal reduction and the opportunity for conventional cementation, benefits many dentists have found desirable.

SURFACE WEAR

Occlusal wear is often thought of as a function of hardness. However, this is a misperception as wear is actually a function of smoothness. Zirconia is a very hard material that has been thought to be very abrasive to opposing tooth structure. However, this is a result of creating a rough surface for the zirconia, not the hardness of the zirconia. There is some discussion as to the optimum surface for a zirconia restoration. Oven firing a ceramic glaze to the zirconia creates a very smooth surface, however the glass-containing glaze is a thin layer of about 100 microns and will wear in function over time. This would expose a potentially rough surface of the zirconia, possibly leading



Sirona TZI-C sintered crown (above); standard milled pre-sintered restoration (top right); Zirconia disc size comparison (right)



to abrasive wear of the opposing dentition. For this reason, it has been recommended to polish the occlusal surface of the zirconia prior to glazing it. This would maintain the smooth surface in spite of the wear of the glass-containing glaze layer. The opposing opinion holds that even if the surface of the zirconia is polished, it will also wear, resulting in the same surface profile as if the glaze was applied and degraded during function. Current laboratory studies reveal that polished zirconia is wear-compatible with the opposing dentition similar to the glazed zirconia. Sintered, unpolished zirconia is the most abrasive to the opposing dentition. A second aspect of this discussion is concerning adjustment of the crowns post-cementation. Any adjustment to the surface of the zirconia must be repolished to return the smooth surface to the restoration. Failure to do so may result in abrasive wear of the opposing dentition. Most of the evidence for the wear caused by zirconia is a result of laboratory studies with simulated occlusal function systems. Clinical research is needed to determine the clinical significance of this concept.

ESTHETICS

Zirconia is not as translucent as glass-containing ceramics and will mask underlying tooth discoloration very well. This is a consideration when trying to match the esthetic appearance of anterior teeth, as zirconia will not exhibit the chameleon effect of absorbing surrounding tooth color as well as more translucent glass-ceramic restorations. The increased zirconia opacity also lends a brighter appearance to the zirconia crown. It can be somewhat problematic to decrease the value of the crown with surface stains and glaze. And the increased opacity of the zirconia also prevents the cement color from influencing the final shade of the crown.

ADHESIVE BONDING OF ZIRCONIA

Increased surface roughness provides a more extensive area for adhesion. Zirconia is polycrystalline and does not contain glass. This is significant because etching glass is the process by which glass-containing ceramics are adhesively bonded to the tooth. Therefore, this is not an option for zirconia restorations.

Some reactive agent needs to be imparted to the surface of the zirconia to have the potential for adhesive bonding. A hydrophobic phosphate monomer, 10-methacryloyloxydecyl dihydrogen phosphate (10-MDP) has reported ability to bond to zirconia. Air abrasion with silica acid modified alumina (CoJet Sand) and the application of an MDP-containing bonding/silane coupling agent mixture increases the bond strength between zirconia and resin cements. Although a degree of adhesion is possible with zirconia, cementation with resin-modified glass ionomer cements (RMGIC) is generally preferred as it is a more efficient clinical technique with easier clean-up.

The strength of zirconia and opportunity to cement rather than bond zirconia crowns requires more mechanically retentive tooth preparations compared to those advocated for adhesive ceramic restorations. A cemented crown requires at least 3.0 mm of clinical preparation height to resist dislodgement. The degree to which an adhesive cement for zirconia crowns with less than 3.0 mm preparation height may ensure adequate resistance to dislodgement is unknown.

CONCLUSION

The tooth preparation will be a more significant influence on the risk of crown dislodgement compared to adhesively bonded glass ceramics since RMGIC will contribute little to adhesive retention of the crown. The surface hardness of zirconia will emphasize the need for accurate design of crown contours and contacts to avoid, or at least minimize, the need for post-sintering adjustment and repolishing. And the brighter, less translucent appearance of zirconia will have an impact on the esthetic application of full contour zirconia crowns in the anterior dentition.

The high strength of full-contour zirconia is a desirable feature, as it prevents the most common failure of glass ceramics: chipping and fracture. This may be an advantage in high-stress clinical situations with potentially limited interarch space to create the 1.5 mm occlusal reduction required for glass ceramic restorations. The opportunity to cement with a RMGIC is obviously an advantage in clinical ease and efficiency. Chairside full-contour zirconia crowns will afford many clinicians a very strong, fracture-resistant alternative restorative material. ■

For questions and more information, Dr. Fasbinder can be reached at djfas@umich.edu.