ZIRCONIA Tips & Tricks

with Paul Cascone, BE MetE, MS

Zirconia Fracturing

Q: What is the primary reason for zirconia fracturing?

A: Thermal Shock

It may be surprising to learn just how sensitive dental zirconia is to thermal shock.

Most times the units survive standard processing, but other times they result in a fracture. One example of when zirconia may result in a fracture is during glazing of the zirconia units.

There are a number of things to keep in mind when glazing:

1) **Always use a low temperature glaze.** The glaze should fire below 900^{0} C and preferably below 800^{0} C. The higher the glazing temperature, the greater the chance for a thermal shock fracture.

2) **Always fire in air.** Vacuum may degrade the zirconia surface causing the material to transform and fracture.

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Contouring Zirconia

Q: How does contouring affect zirconia?

A: Tensile forces develop in the ceramic during finishing and can cause zirconia fracturing

We need diamonds to modify zirconia but we cannot use tools that are metal backed. Using a hard diamond disc (diamonds imbedded in a metal disc) will produce high temperature and tensile forces in the groove that is cut into the ceramic by the diamonds. This will result in a crack perpendicular to the direction of the groove. The most obvious case is when one is trying to open up embrasures on a bridge. In some cases, the crack will extend throughout the connector area, fracturing the bridge.

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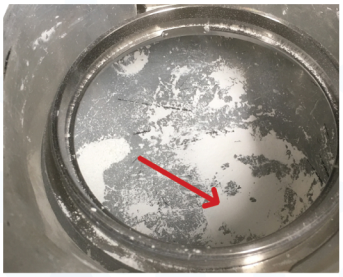
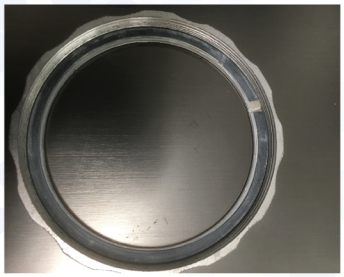
4 Tips for Preventing Zirconia Fractures

Sintered zirconia can be very strong, but the pre-sintered discs are not. The discs can be fractured internally when placed in the milling machine. Fractures in the disc can result in parts prematurely falling out of the disc during milling or parts having micro-fractures that only show after sintering. **Here are some tips for preventing fractures:**

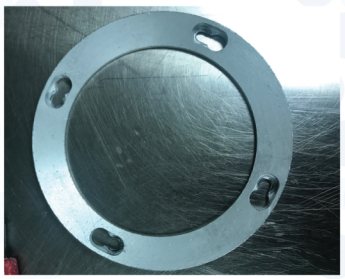
1) Clean the area where the disc rests after every run so the disc lies flat in the holder. The machine software expects the disc to lie flat in order to mill the parts correctly. If some of your bridges do not fit correctly, an uneven surface may be a possible reason.



2) The inside of the top holder also should be cleaned to ensure the screw threads operate properly. Please take notice of the grommet on the inside of the top ring holder. This grommet presses on the disc so that the pressure is uniformly applied. If the opposite side has not been cleaned, there will be pressure points on portions of the disc where the residual zirconia powder was left. The pressure points may create fine fractures in the disc.



3) Disc holders, as shown here, can also create pressure points when the screws are excessively tightened for the type of zirconia used. Less torque placed on the screws is necessary if the disc does not have a plastic ring.



4) Avoid over-tightening the disc in the machine as excessive pressure will create fractures.

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Preventing Zirconia Fractures

The process of removing milled zirconia units from the disc can introduce fractures in the zirconia units.

Here are a few things to watch for:

1) Most technicians use high-speed air turbines to remove the zirconia units. This is an efficient process. However, it is important to remember that the carbide bur on the high-speed turbine is not as hard as the zirconia particles. Because of the difference in hardness, bur life is expected to be short. Therefore, replace burs on a regular basis.

2) Additionally, the bur should not be 'pushed' through the zirconia support. Forcing the bur through the support will result in zirconia cracking. It is best practice to allow the cutting tool to do the separation. Continually run the sides of the rotary tool tip as close as possible to the disc and against the side of the support. Move the tip back and forth, never forcing the tool into the support material.

3) For units nested part-to-part, aim the rotary tool tip at the middle portion of the support between the parts to avoid touching the surface of the unit with the carbide bur. The high frequency vibrations may cause fine fractures in the zirconia, which will not be visible until after sintering.

4) When cutting the last support, ensure that the zirconia unit does not fall through onto a hard surface. Damage to the margin or the walls of the units will result.

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Avoiding Zirconia Fractures

The correlation between biting force and occlusal thickness.

The location of a restoration, and consequently the biting force as shown in Figure 1, is critical to determining the required strength level of a zirconia material. Most fractures occur to molars and pre-molars as a result of the high stress they endure in the back of the mouth. To avoid fractures, the occlusal thickness must be adjusted to compensate for the strength of the selected zirconia material.

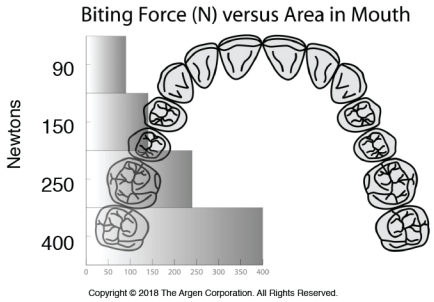

Figure 1

For example, as demonstrated in Figure 2, if a zirconia restoration with a flexural strength of 1100 MPa needs to withstand a force of 400 Newtons, then the minimum occlusal thickness needs to be 0.6 mm. In short, the preparation design must accommodate the strength of zirconia used.

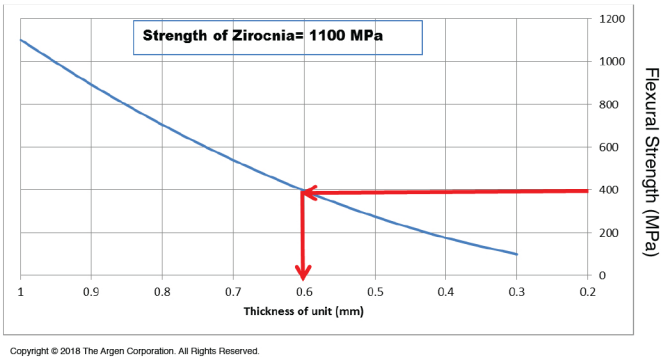

Figure 2

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The ‘Y’ Classification of Zirconia

Have your dentists asked you how much yttria there is in your zirconia? Typically, this question comes after the dentist has been to a lecture or heard other clinicians refer to “3Y” or “5Y” zirconia. This classification system is called the "mole percent" of yttria present in the zirconia. Most companies provide a weight percent of zirconia rather than mole percent. The table below shows the comparison between the two systems as well as some examples of zirconia brands that fall within each category.

Weight Percent Yttria:	Mole Percent Yttria:	Example Zirconia:
5.5 weight percent	3 mole percent (3Y)	ArgenZ Ultra, ArgenZ Esthetic, BruxZir, NexxZr
6.9 weight percent	4 mole percent (4Y)	ArgenZ HT+
9.3 weight percent	5 mole percent (5Y)	ArgenZ Anterior, BruxZir Anterior

To learn more about how to calculate mole percent please refer to this link:
https://sciencing.com/calculate-mole-percent-8248185.html

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