Lava™
Zirconia

It's Better to Go with Someone You Trust

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“e.max LITHIUM DISILICATE IS THE MOST ROBUST CERAMIC SYSTEM TESTED TO DATE.”

* ... according to one scientific study that raises a lot of questions
Response to recent claims from Ivoclar Vivadent

1. Not all zirconia restorations are the same
   - Study proved that unsupported Ivoclar zirconia restorations perform poorly. (~3 month lifetime)
   - Studies and real-world data with Lava™ zirconia show very different results

2. Proper support of porcelain is key to zirconia restoration success
   - Design technique used in Ivoclar-marketed study leads to failure
   - Design technique used with Lava system leads to success

3. Lithium disilicate is not the universal restoration material
   - Remember Empress 2?
   - Trade-off between esthetics and strength
   - Loses strength in a wet environment
   - Limited indications and clinical uses
   - Requires aggressive preparation
1. Not All Zirconia Restorations are the same
Study comparing Ivoclar materials helped prove that unsupported Ivoclar zirconia restorations perform poorly.

“The hand-layering technique on ZirCAD resulted in a limited reliability where at 200N approximately 90% of the specimens failed by 100,000 cycles.”

—Mouth Motion Fatigue Study 2009*

In other words, the zirconia restoration tested in this study would fail after roughly 3 months in the mouth . . .

This is not what we are seeing in real clinical situations.

*Mouth Motion Fatigue and Durability Study
Petra C. Guess, Ricardo Zavenelli, Nelson Sillva, and Van Thompson, NYU
In-vitro studies with Lava™ zirconia show very different results than the study marketed by Ivoclar.

* Minimum occlusal thickness acc. to IPS e.max CAD IFU is 1.5 mm vs. 1.1 mm for Lava DVS
Lava™ Zirconia Restorations highly successful in clinical studies and the real world

- **Lava™ Zirconia Clinical Track Record**
  - 7+ years of clinical history³
  - #1 in U.S. market share¹
  - #1 brand name requested by dentists²
  - Excellent survival rate on multiple clinical studies³
  - 6-year clinical performance of 4.5 stars from Dental Advisor

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¹ iData 2009 In-Lab CAD/CAM Prosthetic Devices
² Source: Key Group Market Research, July 2007.
³ Q. Of all your zirconia cases, what brand of zirconia is requested most often?
³ See 3M ESPE Expertise Lava Zirconia Clinical Studies Booklet
Posterior Single Unit Fracture Rates
Glidewell Laboratories

- Empress CAD All-ceramic (Ivoclar Vivadent): 3.26%
- Procera Zirconia (Nobel Biocare): 2.66%
- Cercon Zirconia (Dentsply): 2.36%
- Prismatik CZ Zirconia (Glidewell): 1.61%
- Lava™ Zirconia (3M ESPE): 1.61%
- Proceram PFM (Glidewell): 1.53%

Data Source: Glidewell Laboratories
- Includes porcelain chips and fractures
- Fabricated between 7/1/08 and 9/30/08
- Fracture data 12 months after fabrication
- 34,953 total restorations
“Zirconia restorations are the future in dentistry and will eventually replace most PFM restorations.”

—Consultant comment

“3M ESPE Lava Crowns and Bridges performed exceptionally well over the six-year evaluation period in their resistance to fracture and marginal staining and exhibited minimal wear.”

—August/September 2009
For more information on Zirconia ...
2. Proper Support is Key to Zirconia Success
Proper Porcelain Support is Key to Zirconia Success

Photographs from Gordon J. Christensen, DDS, MSD, PhD, TRAC Research Study

"Dentists must ensure that their lab technicians are taking care to properly design zirconia and PFM frameworks. The frameworks should have a ‘miniature crown anatomy’"

—Gordon J. Christensen, DDS, MSD, PhD
e.max ZirCAD zirconia restorations were designed without support in the Ivoclar study*

Poor design example (unsupported porcelain)  
IPS e.max ZirCAD zirconia restoration used in recent study*

*Mouth Motion Fatigue and Durability Study  
Petra C. Guess, Ricardo Zavenelli, Nelson Sillva, and Van Thompson, NYU
Proper Support is Key to Success: an example

Because the glass is properly supported, it is strong enough to hold heavy objects and protect the base.
Proper porcelain support is key to zirconia success

3-point bending test:
Beams with porcelain [only] recorded mean tensile strengths from 77 to 85 MPa, whereas beams with zirconia [and porcelain] recorded moduli of rupture almost an order of magnitude higher, 636 to 786 MPa.

S.N. White, V.G. Miklus, E.A. McLaren, Lang, and A.A. Caputo, J Prosthet Dent 2005;94:125-31
Lava™
Design Software 5.0

Full Contour
Design Software

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Lava™ Final Contour Automation Software:
Automatically designs anatomical substructures

Full Contour Design
Automated generation of anatomical coping
Error message if designed without proper support
Lava Design 5.0 Live Video Clip
Options for Overlay Porcelain over Lava Zirconia

1. Hand-layered: Traditional porcelain
2. Pressed: Milled Wax, Pressable ceramics
3. Milled: Mill glass ceramic, Fused with new Lava DVS
3. Lithium Disilicate is not the Universal Restoration Material
Yes, monolithic restorations have promise, but Lithium disilicate is not the “universal” restoration material

Lithium disilicate…

- Remember Empress 2?
- Loses strength in a wet environment
- Loses strength with fatigue
- Requires trade-off between esthetics and strength
- Limited indications and clinical uses
- Requires aggressive preparation
Initial Flex Strength in 3-pt bend test: ~250 MPa

4.1 Flexural strength of CAD/CAM-manufactured rods

The test rods (3x4x13mm; n=15 per material) were fabricated using CAD/CAM technology (Cerec). Subsequently, their flexural strength was determined with a universal testing machine using a three-point bend test.

![Graph showing flexural strength comparison](image)

Fig. 8: Flexural strength of test specimens fabricated using the CAD/CAM technique (Bindl et al, 2003)²

*www.ivoclarvivadent.com, pdf Scientific Documentation for e.max CAD
Lithium disilicate (Empress 2) loses 20% strength in water

~75% strength loss with fatigue in wet environment

Dynamic 3-Point Bending Strength:
- Three point bending test with dynamically loadings (f=1 Hz, n=1E6) under moist conditions.
  Samples prepared with initial microcracks.

J. GEIS-GERSTORFER et al., Dental Clinic, University of Tuebingen, Germany,
Fatigue behavior of three all ceramic materials, Abstract # 3835 IADR 2002
Esthetic considerations with monolithic lithium disilicate

- When comparing clinically relevant thicknesses Lava Zirconia (0.5 mm thickness) proved to be significantly more translucent than IPS e.max CAD LT (1.5 mm thickness)\(^1\)

1 R. ALKHUNAIZI, R. POBER, and R. GIORDANO, Boston University, MA, USA, Translucency Comparison of CAD/CAM Materials, Abstract # 3154, IADR 2008 Toronto
## Limited indications with IPS e.max CAD

<table>
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<tr>
<th>Fully Anatomic</th>
<th>IPS e.max CAD</th>
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<td>Inlays/Onlays</td>
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<td>Veneers</td>
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<tr>
<td>3-unit anterior bridges</td>
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<tr>
<td>3-unit premolar bridges</td>
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<tr>
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<tr>
<td>3-unit posterior bridges</td>
<td>■</td>
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<tr>
<td>4 to 6-unit anterior bridges</td>
<td>■</td>
</tr>
<tr>
<td>4 to 6-unit posterior bridges</td>
<td>■</td>
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<td>Inlay bridges</td>
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Issued 04/2007
Source: Ivoclar Vivadent
Lava™ System Indications

1) Splinted crowns up to 4 units
2) 5+ unit bridges (up to 48 mm) with a maximum of two pontics next to one another in the posterior area and a maximum of four pontics next to one another in the anterior area.
3) With a maximum of 1 pontics at the position of a premolar or incisor.
4) Tests have proven: Lava™ Zirconia shows a sufficient strength for this indication. However, this type of indication overall can have a higher failure risk due to de-cementation and secondary caries regardless of manufacturer. Please refer to national and regional dental associations for more information.
A big difference in occlusal reduction …

- IPS e.max CAD preparation guideline:  
  > 2.0 mm for full coverage crown!

- Lava Zirconia:
  - Recommended 1,5 mm
  - Can be as low as 1 mm
    (0,5 coping + 0,5 Lava Ceram)

* According to IPS e.max CAD IFU from Ivoclar Vivadent Oct 2009
Documented clinical issues and successes

- Single unit restorations, adhesively cemented, with 1.5 – 2.00 mm occlusal reduction show initial clinical success.

- There is still question when moving beyond those parameters …

<table>
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<tr>
<th>Author</th>
<th>Location</th>
<th>Sample Size</th>
<th>Details</th>
<th>Success Rate</th>
<th>Notes</th>
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<td>Harder, Wolfart, Eschbach, Kern</td>
<td>Kiel, Germany</td>
<td>up to 8</td>
<td>45 inlay-retained three-unit posterior bridges IPS e.max Press, adhesive cementation</td>
<td>50%</td>
<td>Abstract 1638 IADR 2009</td>
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“Conclusions: Inlay-retained FPDs made from lithium-disilicate glass-ceramic in the tested design cannot be recommended because of the high clinical failure rate.” (“Supported by Ivoclar Vivadent.”)
Summary: Lava™ Zirconia Restorations – Stronger than IPS e.max® CAD Where It Counts

- Lava Restorations show a significantly higher initial strength than IPS e.max® CAD monolithic crowns.*
- Lava Restorations are strong enough to be used in clinical situations with a small occlusal reduction in combination with conventional cementation.
- IPS e.max CAD can only go down to 1.5 mm minimum occlusal thickness per the IFU. You can clearly see why. With a thickness of 1.2 mm, the initial strength of Lava DVS is 3 times stronger than eMax CAD.

*Conventionally cemented molar crowns with a minimal occlusal thickness of 1.2 mm. Minimum occlusal thickness acc. to IPS e.max CAD IFU is 1.5 mm vs. 1.1 mm for Lava DVS
Appendix
Your Guide to Digital Dentistry
Lava™
Precision Solutions

1. QUALITY
Precise, Consistent, High-Quality Restorations

Lava™
Chairside Oral Scanner C.O.S.

Lava™
Scan ST Design System

Lava™
CNC 500 Milling Machine

Lava™
Zirconia Restoration

Lava™
Furnace 200

2. PRODUCTIVITY
For the patient, dentist, and dental lab

Zirconia
Glass
Ceramic

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3. FLEXIBILITY for a wide variety of other restoration options

- PFM, Full Cast, or other bradned ceramic restorations
- Lava™ Zirconia for Implant Abutments and Lava™ Zirconia Restoration
- Atlantis™ patient-specific abutments by Astra Tech
- Variety of restoration options via third-party connections
- Metal and pressable ceramic options via milled wax patterns

Lava™ C.O.S.
Lava™ Scan ST Design System
Lava™ CNC 500 Milling Machine
Lava™ Furnace 200
Wax
Zirconia
Glass
Ceramic
Natural Beauty without Compare
In-vitro Studies on Porcelain Support

- „The better the support of the veneering ceramic, the lower the chipping rates.“¹
- “Fracture strength increased by 30% with an anatomical design.”²
- „The crowns with an ‘adapted core’ exhibited significantly higher values than those with a 0,5 mm core“³

¹ D. Steiger, M. Rosentritt, M. Behr et al., University Regensburg, Influence of core design on chipping of Zirconia crowns, CED Munich 2009, Abstract #71
² J. FISCHER, University of Bern, Strength of zirconia single crowns related to coping design, IADR Baltimore 2005, Abstract # 0546