Restorative Dentistry Update 2017

Ceramics

Evolution of All-Ceramic Materials

1889
Porcelain Jacket Crown
1948
Lithium Disilicate
1998
Empress II Lithium Metasilicate
1998
Empress Leucite
2003
LAVA Porcelain fused to Zirconia
2009
BruxZir Monolithic Zirconia
2012
IPS = Inhouse Practice System

Microstructure Classification
Glass to crystalline ratio

<table>
<thead>
<tr>
<th>Category</th>
<th>Type</th>
<th>Composition</th>
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<tbody>
<tr>
<td>1</td>
<td>Glass based system</td>
<td>(mainly silica)</td>
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Clinical Outcomes of Lithium Disilicate Single Crowns: a systematic review
Pieger S, Salmon A, and Bidra AS - JPD 2014

- 2000 papers from 1998-2013 reviewed with 12 articles meeting inclusion criteria
- 841 restorations evaluated
- Failure defined as ant part of the restoration requiring removal or remake
- Posterior failures > anterior failures

Clinical Evaluation of 860 Anterior and Posterior Lithium Disilicate Restorations: A retrospective study with a mean follow-up of 3 years and a mixed observational period of 6 years

- Single Crowns
- Natural Teeth and Implants Crowns
- Monolithic and Bi-layered
- Cumulative survival = 95.4-100%

Polycrystalline Solids
Composition Category 3

- Solid-sintered, monophase
- Dense, air-free, glass-free
- Flexural strength = 900-1100 Mpa
- Fracture toughness is significantly higher than other ceramics
**Polycrystalline Solids**  
*Composition Category 3*

- Used only for cores (LAVA, Vita YZ, and Cercon), until recently:
  - BruxZir—a solid monolithic zirconia restoration
  - Can’t be micromechanically bonded due to absence of glass

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**What have we learned from this evolutionary experience? What material should we be using?**

All-ceramic or metal-ceramic tooth supported FDP? A systematic review of the survival and complication rates.  
Part 1: Single Crowns  
Sailer, et al  
Den Mat, Feb 2015

<table>
<thead>
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<th>Material Survival Rate</th>
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| Leucite or Lithium Disilicate reinforced Glass Ceramic | 96.6%  
| Densely Sintered - alumina | 96.0%  
| Metal Ceramic | 95.7%  
| Glass infiltrated alumina | 94.6%  
| Zirconia | 91.2%  
| Feldspathic / Silica | 90.7%  
|  
Zirconia can be made to be beautiful...
The “Self Healing” Aspect of ZrO₂

- Zirconia goes through disruptive phase changes unless stabilized by 2-3% Y₂O₃.
- Yttria stabilization leads to superior thermal, mechanical and electronical properties.
- Tetragonal Phase is Metastable
  - If stress is applied at a crack
    - Tetragonal => monoclinic => volume increase => crack is compressed => crack propagation decreased => increase in fracture toughness

= Transformation Toughening
Translucent Monolithic Zirconia

- Transformation of tetragonal grains and crystals into larger cubic crystals by increasing temperature and adding dopants and stabilizers will result in a more translucent zirconia.

- The higher the sintering temperature → more cubic crystals → Less Yttria in tetragonal crystals → more susceptible to degradation.

- Increase thickness → decrease translucency.

A Comparative Evaluation of the Translucency of Zirconias and Lithium Disilicate for Monolithic Restorations

- Tested the translucency of 5 zirconias and one lithium disilicate (e.max CAD LT B1)
  - Prettau Anterior, BruxZir, Katana HT, Katana ST, Katana UT

- Conclusions:
  - e.max more translucent than any of the zirconias
  - Katana UT the most translucent Zirconia

Fracture Rate of Monolithic Zirconia Restorations up to 5 years: A Dental Laboratory Study

- Received data from four commercial labs that offer guarantees for monolithic zirconia
  - 39,827 Units completed
    - Single Crowns: 0.71% fractures - FDPs: 2.6% fractures
    - BruxZir, Katana, Zirlux, ZenoStar – no difference reported
    - Most fractured the DAY OF DELIVERY!
    - Must have 0.6-0.8 mm chamfer – no knife edge

...and fit too!

NO FEATHER EDGE WITH MONOLITHIC ZIRCONIA
Load at Fracture of Monolithic and Bilayered Zirconia Crowns with and without a Cervical Collar

Öilo M, Kvam, K, Gjerdet N
JPD, vol. 115, no. 5, May 2016, pp. 630-636

- Vitro study to evaluate load to failure of three different zirconia (Lava) crown designs
  - Monolithic
  - Coping with no collar, layered with feldspathic
  - Monolithic (6517N), Collar (4712N) then No collar (4091N)
  - Crown margin design affects strength more than wall thickness
  - Cracks originate at the cervical, and proximal (10 studies support this)

Zirconia FAQs

- Does zirconia wear the apposing teeth?
  NO – small grain size (less than 1 micron) no wear noted in numerous studies

- What is smoother – polished or highly glazed ceramics?
  Polished – even smoother than highly glazed ceramics

- Can I sandblast zirconia?
  Yes – no strength changes if using 50 micron or less particles

- Can I bond zirconia?
  Yes – Chemically, not micromechanically using MDP monomers like Z-Prime (Bisco) shown to be better than SiO2 tribocochemical reaction (CoJet™, 3M ESPE)

Zirconia FAQs

Polycrystalline Solids
Composition Category 3

- Instruct lab use collars

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Blocking-out to Conserve Tooth Structure
Block-Out Benefits
• Provides “clean start” for operator
• Conserves tooth structure
• Creates uniform wax pattern

Block-Out Benefits
• Reduces irregularities
• Enhances visibility of details
• Improves seating
• Improves fit

Block-out Technique

STEP 1: Low Viscosity Liner
• Better adaptation of filled RMGI
• Paste-paste - consistent mix
• Few voids
• Excellent seal
• Less post-op sensitivity

Liner Placement
STEP 2: High Viscosity Base

- Dual cure
- Machines well
- Fluoride release
- Favorable physical properties

Preparation Design

- Inlays
- Onlays
- All Ceramic Crowns

Light Curing Liner

Base Placement

Inlays

Onlays

All Ceramic Crowns
Ceramic Inlays

**Indications**
- Cannot perform direct composite due to access or other difficulties
- Enamel periphery remains
- Vital tooth
- MUST be able to ISOLATE
- MATERIAL OF CHOICE: Lithium Disilicate
- CEMENTATION: Adhesive, DUAL CURE

**Preparation Parameters**
- Adequate tooth reduction
- Ensures strength of ceramic material
- Smooth, tapered walls
- Ensures good internal adaptation
- Smooth, well-defined margins
- Aids in margin detection and fit
- Rounded internal angles
- Ensures passive seating and prevents fracture
- Exit angles and margins approaching 90°
- Ensures bulk of ceramic at margins for strength

**Pulpal Depth:** Prepare deep enough! evaluated at the central fossa

Use of 847KR in box, round corners, also note boxes are divergent
Ceramic Onlays

Indications
• Enamel periphery remains (BEST)
• Vital or Endo treated tooth
• MUST be able to ISOLATE
• MATERIAL OF CHOICE: Lithium Disilicate or Monolithic Zirconia(?)
• CEMENTATION: Adhesive, DUAL CURE

Clinical Tips...
✓ 27 clamp accomplishes access to distal areas

Desire 2.0 mm reduction over functional cusp and central fissure.
Desire bulk of ceramic at the margin.
Avoid sharp internal angle keep walls smooth.
At least 1.5 mm over non-functional cusps.
Angela
“My new onlay thingy is super sensitive to chewing, and it doesn’t even touch the upper molar when I bite!”

Smooth Transitions
- Avoid sharp angles; potential to prevent seating
- Rounded internal angles ensure passive fit
- Avoid stress points under the ceramic
- Improve internal adaptation and ease of delivery

Onlay Variations

Ceramic
**V onlay s**
Ceramic All Ceramic Crowns

Preparation
Traditional Design

• Remember “1-2-3-4”
  • 1 mm shoulder
  • 2 mm occlusal clearance
  • 3 occlusal planes
  • 4 mm axial wall height

4 mm Axial Wall Height

Preparation
Traditional Design

✓ Shoulder 1 mm deep axially
✓ Rounded internal angle
✓ 90° finish line

Step-by-step Instructions

The ideal PREPARATION STARTS with the Right BUR

Preparation Steps

<table>
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<tr>
<td>Occlusal Clearance</td>
<td>330D</td>
</tr>
<tr>
<td>Occlusal Reduction</td>
<td>860-016/847KR-016</td>
</tr>
<tr>
<td>Interproximal Slice</td>
<td>8788-012</td>
</tr>
<tr>
<td>Shoulder Refinement</td>
<td>8800-016/8847KR-016, 10-839 (end cutting)</td>
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<tr>
<td>Smoothing of Sharp Edges</td>
<td>8800-016/8847KR-016</td>
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Depth

1.5 – 2 mm
Preparation – Occlusal Reduction

Smooth all sharp edges

Visual
Follows facial contours of adjacent teeth

MODIFICATION REQUIRED FOR CHAIRSIDE MILLING

CAD/CAM
Remove 1 mm sharp peaks
Ceramic Fixed Dental Prostheses

INDIRECT PREPARATIONS AND MATERIAL INDICATIONS

<table>
<thead>
<tr>
<th>Description</th>
<th>FPM</th>
<th>FPE</th>
<th>e.max</th>
<th>MONO Z</th>
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<td>Diagrams</td>
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**Preparation Design**

- Laboratory connector dimension requirements
  - IPS e.max
    - 4 mm x 4 mm in posterior
    - 4 mm x 3 mm in anterior
  - Zirconia
    - 3 mm x 3 mm in posterior
    - 3 mm x 2 mm in anterior

**Survival Rate:**

- Multi-unit FDPs
  - | Material          | Survival Rate |
  - |-------------------|---------------|
  - | Metal Ceramic      | 94.4%         |
  - | Densely Sintered - Zirconia | 90.4%         |
  - | Reinforced Glass Ceramic | 89.1%         |
  - | Glass infiltrated alumina | 86.2%         |

**Date:**

- RGS 2/12/17
Material Selection

- **Zirconia**
  - Use Vita CLASSIC shades (A1-C4)
  - Use translucent Zirconia when critical
  - Always milled
  - Monolithic—a solid piece, not veneered with feldspathic porcelain
  - May be surface stained by lab to improve esthetics

Cementation of Zirconia

- Adjust surface with **fine diamond** (30 micron)
- Polish with extraoral Dialite polishers
- If margins subgingival—use Glass ionomer or SARC
- If margins accessible—may chemically bond to tooth with MDP primer and Resin Cement

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![Graph showing clinical outcomes of lithium disilicate single crowns and partial fixed dental prostheses](chart.png)