CEREC Chairside Materials

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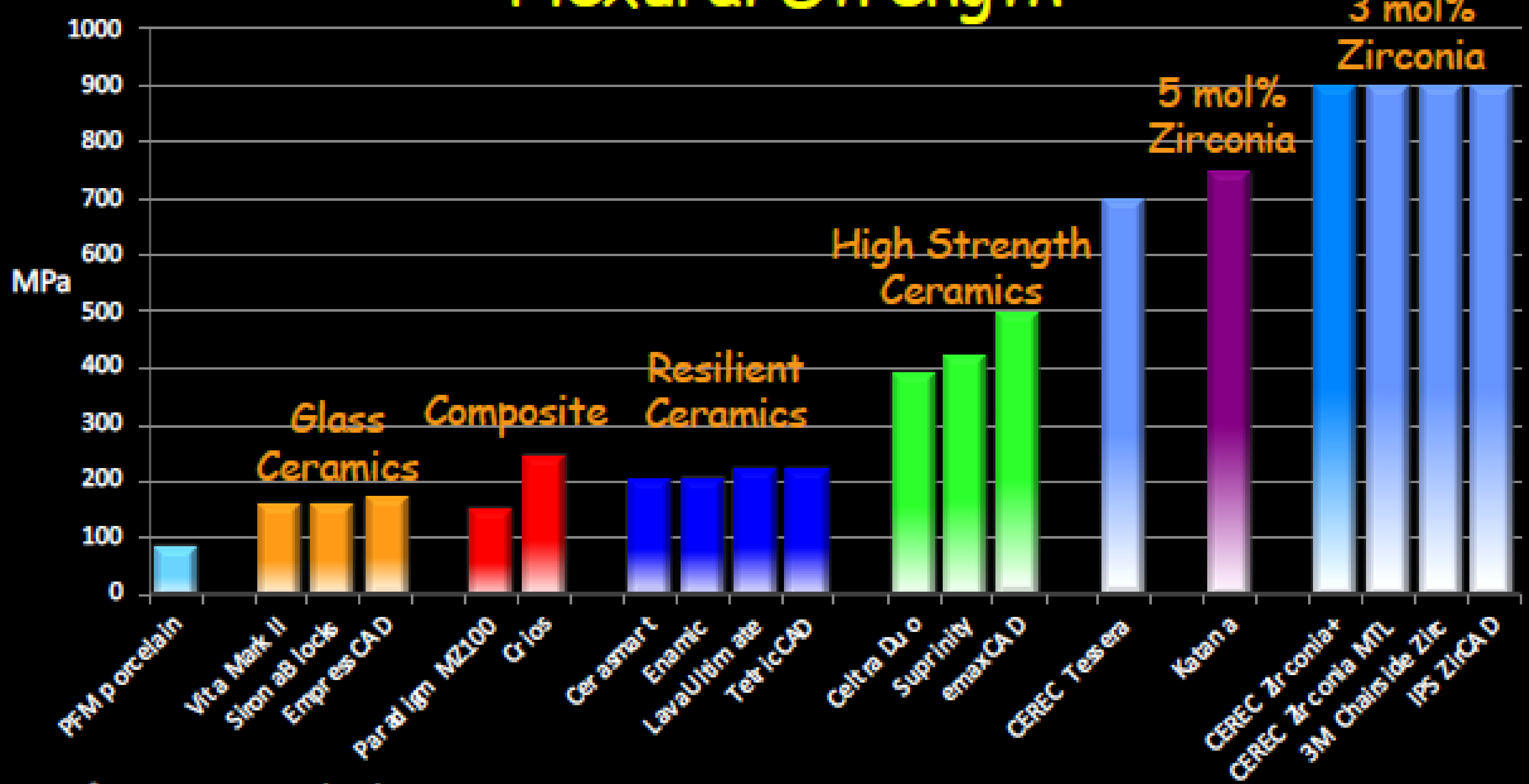
Skill Development

- Mill (grinding) > Hand polish Principles of contouring, surface texture, and polishing; extra- and intraoral Material needs no post-milling processing relative to physical properties
- Mill (grinding) > Glaze finish Esthetic modification of the restoration Basics of restoration support, glaze application, oven firing
- Mill (grinding) > Crystallize + Glaze Advanced application of support materials, longer firing cycles
- Mill (dry milling) > Sinter + polish

Volumetric shrinkage; hand polishing, glazing

Flexural Strength



Manufacturer reported values

How strong is strong enough?

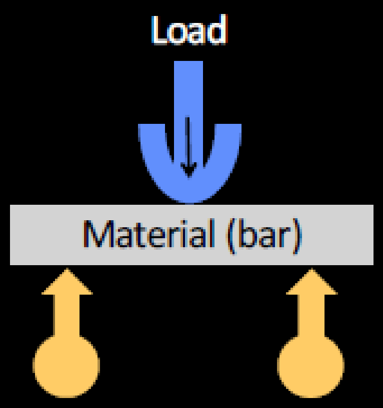
- Strength is NOT an inherent property; it is conditional as it is influenced by material dimension, processing, and handling.

Material	Fracture Toughness
Metals	30-75
Zirconia	7.0-11
Ceramic	3.0-5.0
Composite	1.5-3.0

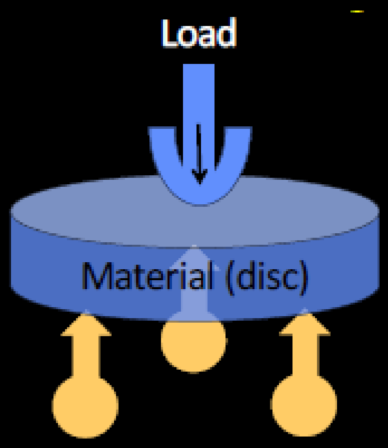
Test Design Matters

- Both flexural test methods are accepted according to ISO 6872:2015

3-point flexural strength



Biaxial flexural strength



MPa << MPa

Influence of material thickness on fracture strength of CAD/CAM crowns. Zimmerman, et al Dent Mater 2017.

- Measured maximum fracture load; all crowns adhesively cemented to SLA dies with Variolink II
- 3 groups/material: varying thicknesses of 0.5, 1.0, and 1.5 mm

	Vita Mark II	emaxCAD	Enamic	Suprinity
0.5 mm	---	---	---	---
1.0 mm	482.0 c	774.2 b	771.7 b	615.0 c
1.5 mm	634.8 c	1,240.8 a	1,063.6 ab	1,092.5 ab

(---) = did not survive fatigue testing prior to fracture load test

- All groups survived fatigue testing at 1.5 mm thick magic #
- Significant loss of strength by reducing thickness of the material

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Adhesive Glass Ceramics

when you mention cerec, think adhesive glass ceramics

- Feldspathic Porcelain

  Vitablocks Mark II (Vita) - 1991

  CEREC Blocs (Sirona) - 2007

  Fine grained - ave particle size 4 μm
- Leucite-reinforced porcelain

  IPS Empress CAD (Ivoclar) – 1998 esthetic

  High translucency, Chameleon effect
- Moderate strength ~150-175 MPa
- Abrasive wear similar to enamel
- Etch with HF acid to bond
- Polish or glaze for efficient handling

CAD/CAM (CEREC) Performance Summary Studies 1991-2006 (over 4000 restorations) Clinical performance of chairside CAD/CAM restorations

DJ Fasbinder, JADA, 2006 137:225-315

Studies (all total etch)	Time	#Rest	%Failures	%Fracture
Mörmann, et al,1991	3 yrs	94	2.1	2.1
Isenberg, et al, 1992	3 yrs	121	5.8	5.8
Brauner & Bieniek, 1996	6 yrs	453	5.5	1.2
Heymann, et al, 1996	4 yrs	50	0	0
Hass, 1996	10 yrs	219	2	0.5
Berg & Derand, 1997	5 yrs	115	2.6	2.6
Cerutti, 1998	7 yrs	109	0	0
Fasbinder, et al, 2001	3 yrs	92	3.3	2.2
Otto & DeNisco, 2002	10 yrs	200	8	4.3
Posselt & Kerschbaum, 2003	10 yrs	2328	1.5	0.3
Fasbinder, et al, 2006	6 yrs	80	5.0	2.5
Reiss, 2006	18 yrs	1011	8.5	3.3

Fasbinder, Neiva, Heys, Heys, JERD 2020

- 120 Lava Ultimate and EmpressCAD onlays; bonded with total etch (Excite + Variolink
- II) or self-etch (SUA + RelyX Ultimate)
- 3 onlays fractured; 3 fractures of adjacent cusps over 5 years; 95% success rate

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Resilient Restorative Materials

- Ceramic materials are brittle and require increased strength to improve fracture resistance
- Alternative approach to preventing restoration chipping and fracture; create more resilient materials that can absorb a greater stress load without fracture or failure
- Desire a stress-absorbing material that can be handled with the ease of composite yet function with surface characteristics of ceramics

Resilient Ceramics

polymer + ceramic -> hybrid

- Lava Ultimate (3M)>2011

Nano-ceramic

- TetricCAD (Ivoclar)>2018

Hybrid ceramic

- Cerasmart (GC)>2013

Force absorbing hybrid ceramic

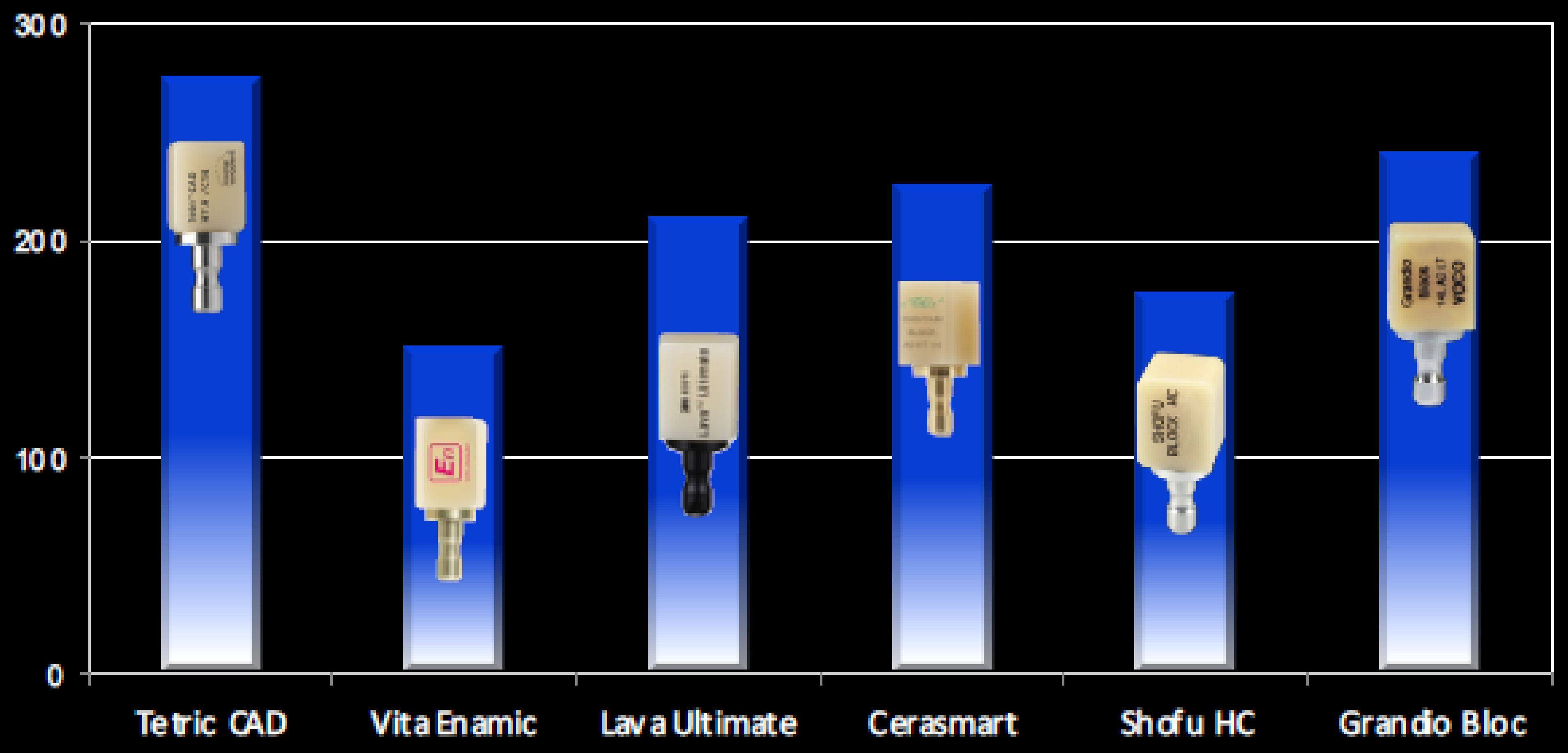
- Enamic (vita)>2011

PICN ceramic = feldspathic
Porcelain in a polymer network

- Shofu Block HC (Shofu)>2017

Hybrid ceramic resin block

Flexural strength



Resilient Ceramic Clinical Studies

long term provisional, stronger than PMMA

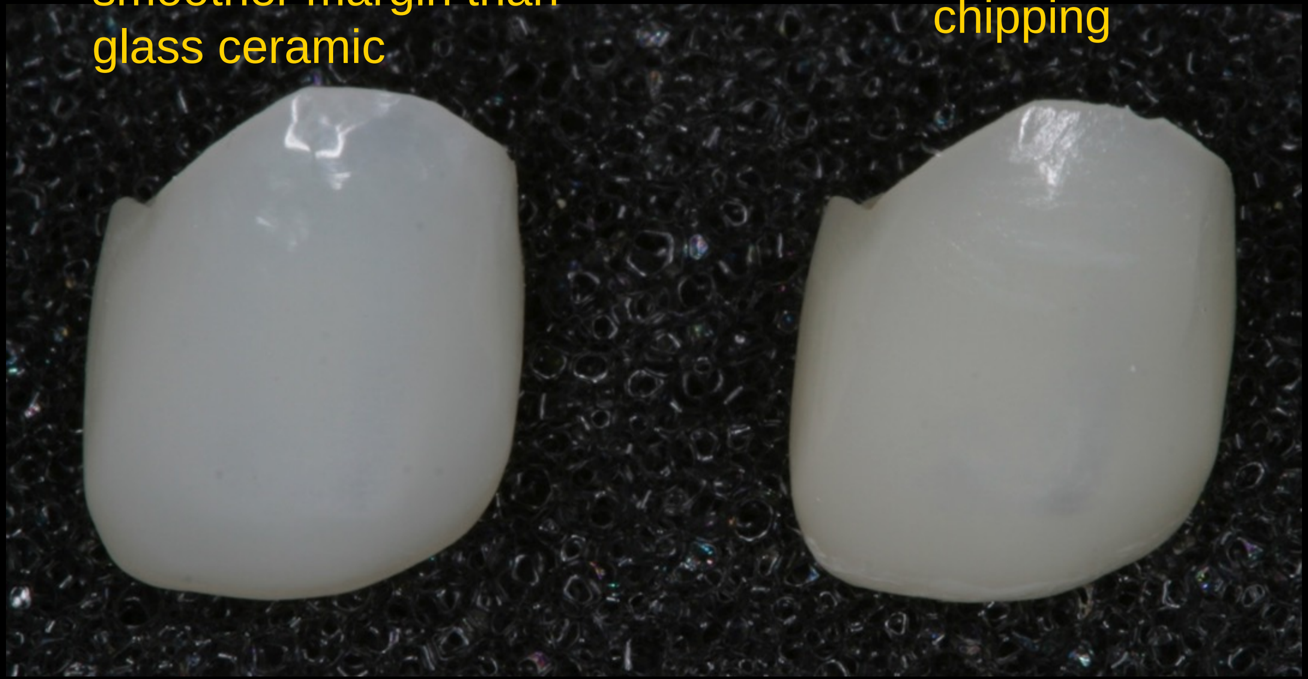
- Zimmerman, et al J Prosthodont 2017 Apr

42 Lava Ultimate onlays; 2 yr recall = 3 debonds, 2 onlay fractures, 85.7% success rate

- Lu, et al. J Prosthet Dent. 2017 Jul 67 Enamic onlays; 3 yr recall = 1 debond, 1 onlay fracture 97% success rate

- Spitznagel, et al. Clin Oral Investig. 2017 Dec 103 Enamic inlays/onlays; 3 yr recall = 3 onlay fractures 95.6% success rate

Resilient Ceramic Margins




Fracture
most common ceramic failure

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Oven Workflows

- Increased post-mill processing time and effort Glazing (optional)
- Low fusing porcelain fused to surface of the restoration using a firing cycle

 ~10 min; no change in strength to the restoration, just esthetic modification

- Matrix Firing (mandatory)

 Rapid SpeedFire oven cycle (< 5 min) for CEREC Tessera to maximize strength properties

- Crystalizing (mandatory)

 Vacuum firing cycle ~15-25 min to increase density and shift crystal structure to create maximum strength in the restoration

IPS emaxCAD (Ivoclar)

- Introduced 2005
- First “high strength” glass ceramic
- Lithium disilicate – patented by Ivoclar
- Available forms

emaxCAD > CAD/CAM

emax press > press-fit (laboratory)

- Popular due to the good combination of esthetics and high strength

IPS e.max CAD (Ivoclar)

Coping/layering

Full contour & cut-back

Full contour & staining/glazing

10 yr Clinical eval of chairside lithium disilicate CAD/CAM crowns
Fasbinder, Neiva, Heys Heys, J Dent Res 2018

- 100 IPS e.max CAD crowns placed chair-side with CEREC 3D (v2.80)
- Cements >

  Phase 1 = MultiLink and an experimental self-etching cem

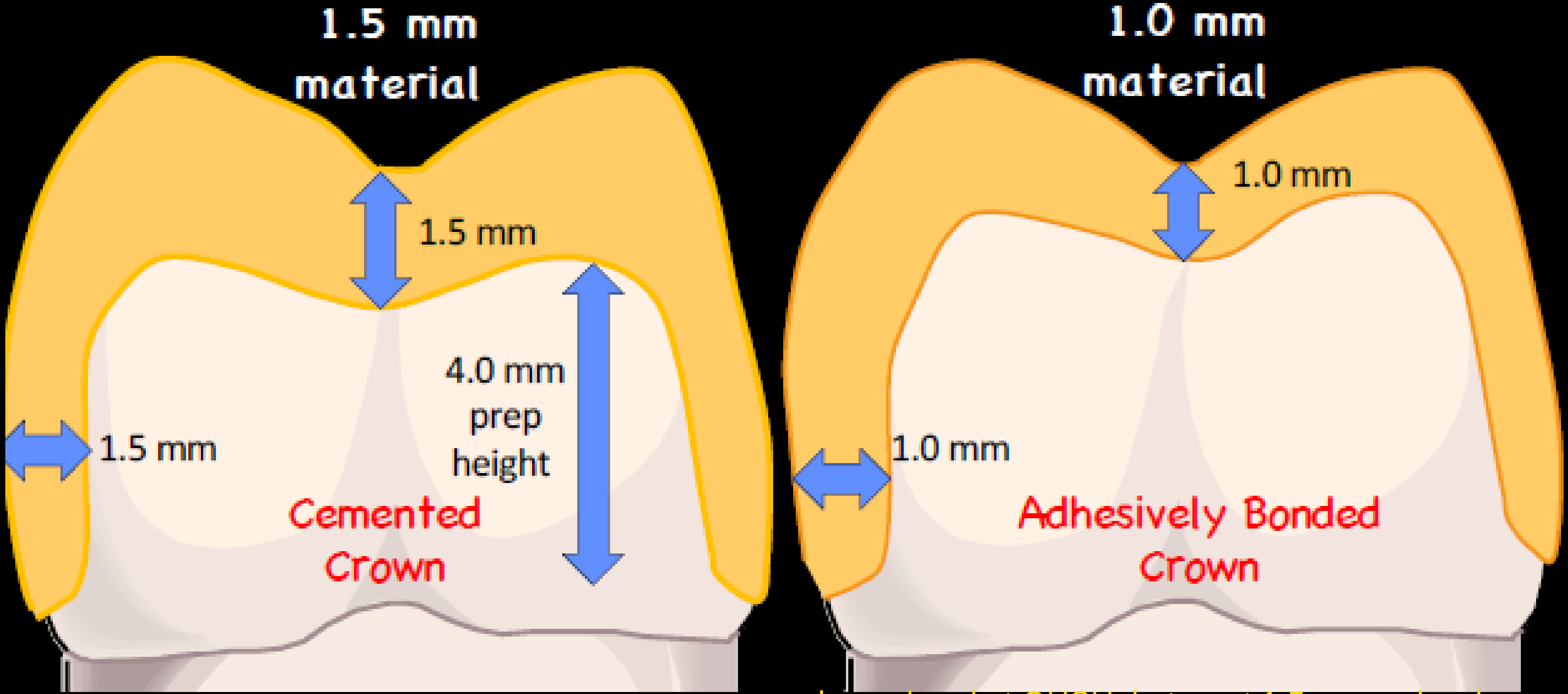
  Phase 2 = New group of 38 crns cemented with SpeedCem

10 yr Clinical eval of chairside lithium disilicate CAD/CAM crowns
Fasbinder, Neiva, Heys Heys, J Dent Res 2018

- Evaluated yearly with USPHS criteria for 10 yrs
- 5 year recall :
  No post-op sensitivity
  No ceramic chipping
  No crown fractures
- 10 year recall:
  2 cusp fractures
  1 core fracture (crown intact)
  1 RCT

emaxCAD Preparation Guidelines

full contour posterior crown (Nov 2016)



we always bond at OHSU, but want 1.5mm occlusal reduction

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Zirconia

- 99% of dentists used it for natural teeth; 76% used it for implants
- 98% used it for posterior crns; 61% used it for anterior crns dont need Zr str for anterior in most cases
- Primary disadvantages = restoration removal, shade matching/translucency esthetic: feldspathic > emax > Zr
- Primary advantages = flexural strength or fracture resistance
- Most common complications

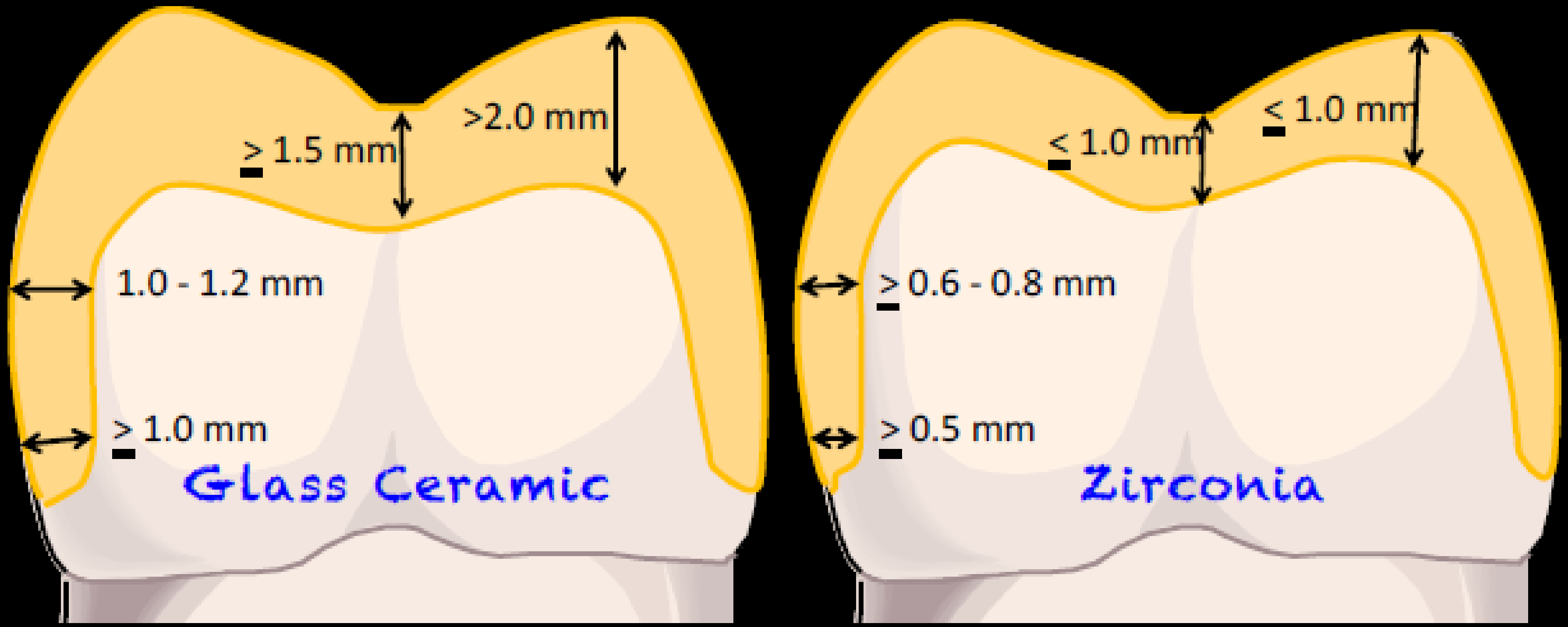
52% debonding

31% opposing tooth wear remember to polish Zr, esp occlusal

23% restoration fracture (veneered zirconia)

Strength with Reduced Thickness

More conservative tooth reduction



Fracture Resistance of monolithic zirconia molar crowns with reduced thickness. Acta Odontol Scand 2015; 73(8):602

- The fracture rate of monolithic zirconia crowns (Lava Plus/4 mole%) were compared at different axial (0.5, 0.7, and 1.0 mm) and occlusal thicknesses(0.5, 1.0, and 1.5 mm)
- Axial reduction did not significantly influence the fracture rate
- Significant difference in crown strength based on the occlusal thickness with 1.5 mm having the greatest fracture resistance
- Reducing the occlusal thickness of the crowns resulted in decrease in fracture resistance
- Min occlusal reduction for 3 mole% zirconia is generally 1.0 mm and for 4 mole% zirconia 1.2 – 1.5 mm due to reduced flexural strength

Zirconia categories

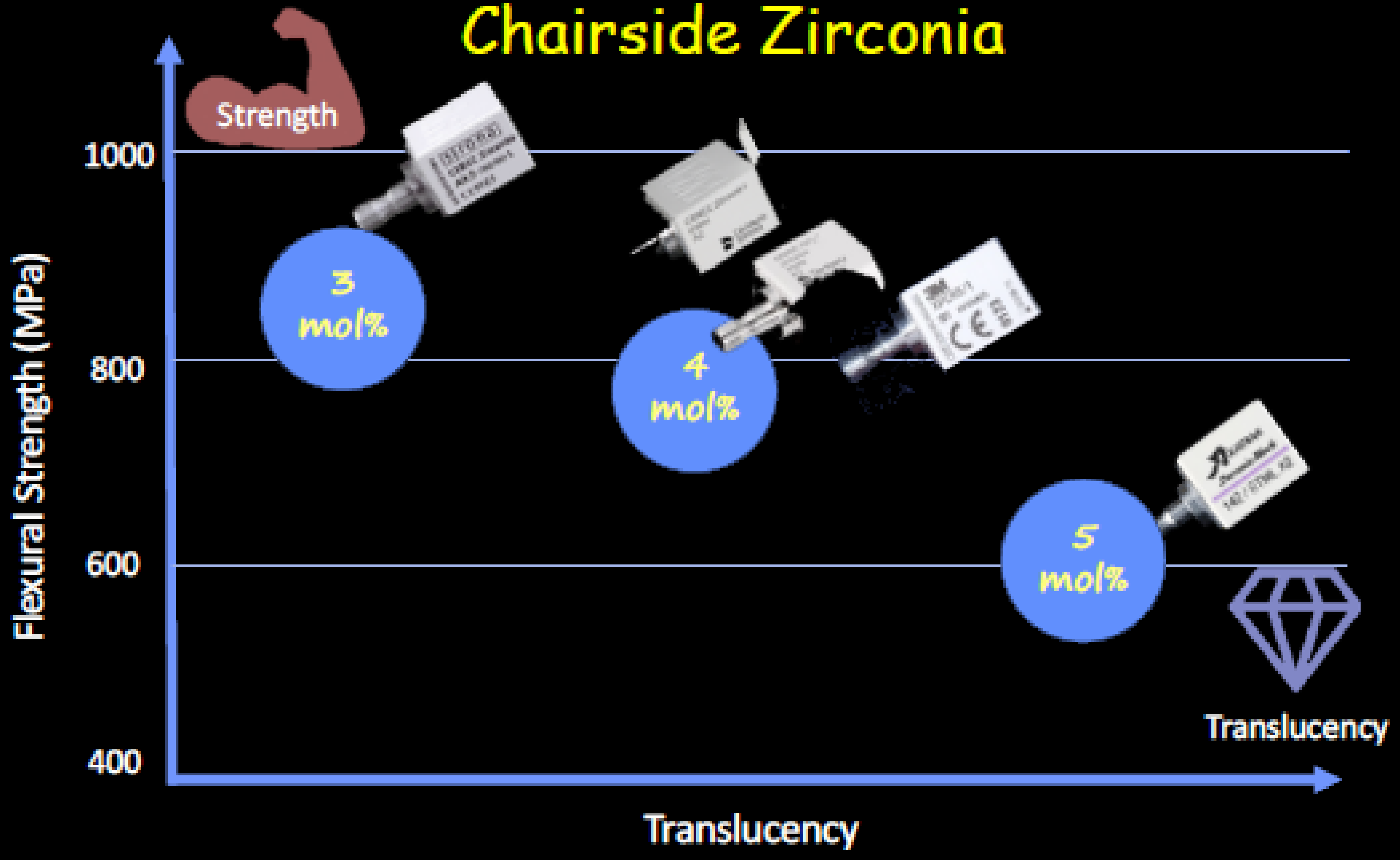
3Y-TZP = 3 mole%	4Y-TZP = 4 mole%	5Y-TZP = 5 mole%
Intro prior to 2010	>2014	>2017
Opaque, high value	Improved translucency	Approaching glass ceramic
85%+ tetragonal 0% cubic	25% Cubic 75% tetragonal	> 50% cubic < 50% tetragonal
High strength > 900 MPa flex str	Reduced strength ~800 – 850 MPa flex str	Moderate reduced strength ~600 – 750 MPa flex str
Fracture Toughness (5 – 9 MPa•m1/2)		Fracture Toughness (2.2 – 4 MPa•m1/2)

Examples: Lava Zirconia (3M), BruxZir (Glidewell), Cercon (Dentsply Sirona), IPS emax ZirCAD MT (Ivoclar Vivadent), and CEREC Zirconia (Dentsply Sirona)

Examples: Lava Plus (3M), IPS emax ZirCAD Prime (Ivoclar Vivadent), 3M Chairside Zirconia (3M)

Examples: Lava Esthetic (3M), Katana Zirconia
UTML/STML (Kuraray Noritake), BruxZir Anterior
(Glidewell Laboratories), and ArgenZ Anterior (Argen Corp.)

Chairside Zirconia



Zirconia processing

- Must be milled due to 22-24% shrinkage when sintered

Need CAD program to manage the expansion/contraction

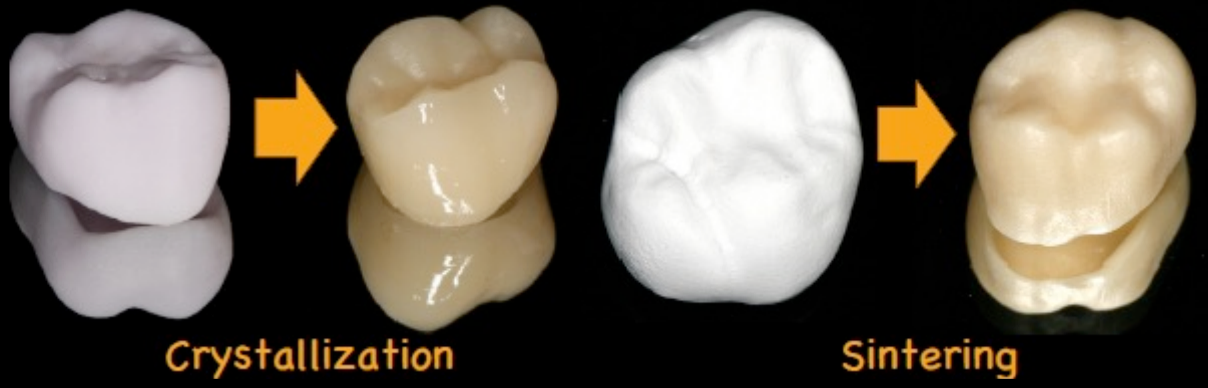
- Milled in a “green state” for efficient milling

Dry mill with carbides to avoid water

- Requires sintering process at high temp to achieve maximum physical properties

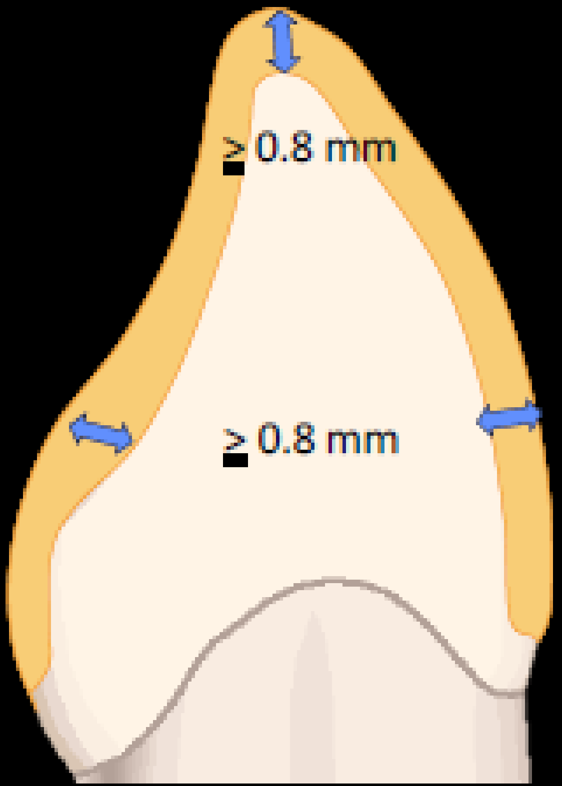
Sintering vs Crystallization

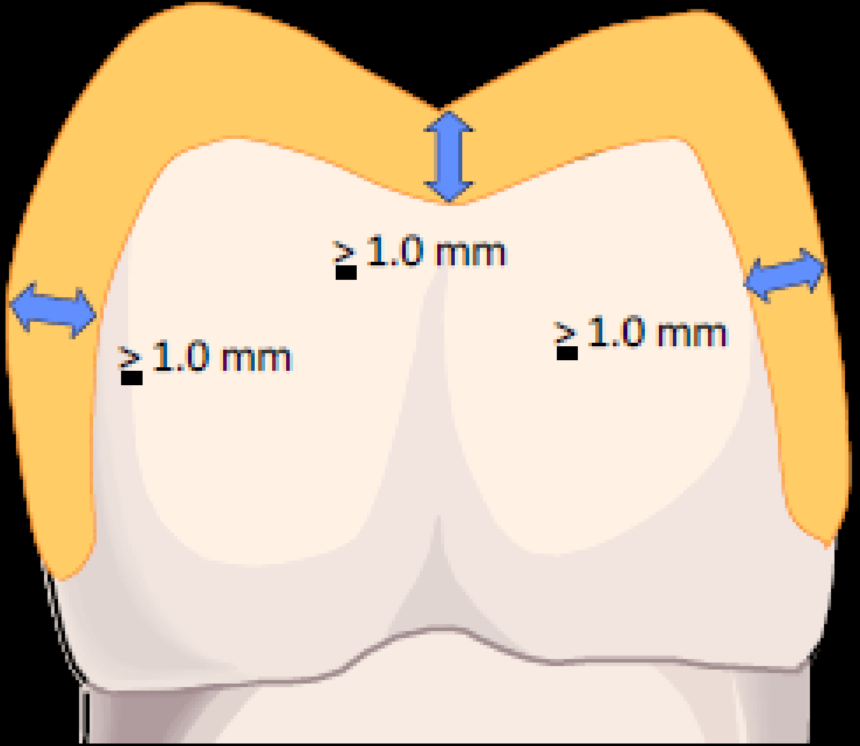
- Crystallization > high temperature to create a shift in crystal structure; risk of small volumetric shrinkage, ~0.2% Lithium disilicate/emax
- Sintering > process of compacting and forming a solid by heating without melting it to the point of liquefaction; controlled large volumetric shrinkage Zirconia; uses carbide bur?, less chipping



Katana Preparation Guidelines

- 5 mol% zirconia





When cementing bonding restorations you need an assistant

Black for silane
Red tips for HF

Special thanks to Dr. Dennis J. Fasbinder, University of Michigan

When cementing you can pack cord so
cement won't go into sulcus