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"UPDATE ON FIXED PROSTHODONTICS AT UTHSC:
AND YES, GOLD AND PFM ARE STILL ALIVE"

DR. TOM KORIOTH





Department of Prosthodontics


Confusion #1

Fixed Dental Prosthesis (FDP)

SINGLE UNIT



MULTI-UNIT



fixed partial denture (FPD)

Thanks to the Glossary of Prosthodontic Terms (GPT)

TKF-FPDs 2016

1. Understand that the choice of material for a fixed prosthetic dictates the preparation design.

"Material of crown dictates preparation"

FULL COVERAGE CUTS:
 GOLD → more conservative
 e.max® → less conservative (more axial reduction)

TIM PICS 2015

Classification

Confusion #2

GOLD FULL CAST **METAL**

PFM GLASS on **METAL**

ALL-CERAMIC MOSTLY GLASS

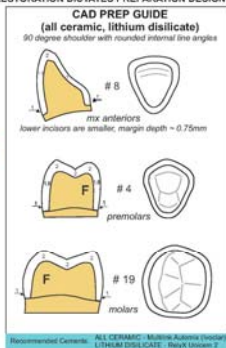
GLASS INFILTRATED (e.max®)

POLY-CRYSTALLINE (BruxZir®)



Fixed Prosthodontics Guidelines for Crowns©

RECOMMENDED MINIMUM IDEALS - MATERIAL OF RESTORATION DICTATES PREPARATION DESIGN





With many thanks to Drs. Jay Leo, Jim Simon & Mike McBride

Fixed Prosthodontics Guidelines for Crowns

RECOMMENDED MINIMUM IDEALS - MATERIAL OF RESTORATION DICTATES PREPARATION DESIGN

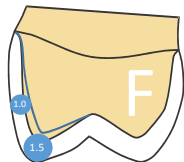
CAD PREP GUIDE (all ceramic, lithium disilicate)
<p>90 degree shoulder with rounded internal line angles</p> <p> FULL ZIRCONIA FULL ZIRCONIA (Monolithic (ALL) Zirconia) FULL COBALT CROWN (FGC) Uniform .8mm chamfer all around / Functional cusp </p> <p>Recommended Cements: Rely-X-Unicem 2 or Fuji Plus</p>
<p> Porcelain or Lithium Disilicate Lithium Disilicate </p> <p> Porcelain Fused to Zirconia (PFZ) with full porcelain occlusal coverage Buccal 90 degrees 1.3mm chamfer Lingual .5.5mm chamfer Functional cusp beveled 2mm all porcelain occlusal </p> <p>Recommended Cements: Rely-X-Unicem 2 or Fuji Plus</p>
<p> ALL CERAMIC - MULLINIA Australia (Nidolas) LITHIUM DISILICATE - Rely-X Unicem 2 </p> <p> Porcelain Fused to Metal (PFM) with full porcelain occlusal coverage Buccal 90 degrees 1.3mm chamfer Lingual .5.5mm chamfer Functional cusp beveled 2mm all porcelain occlusal </p> <p>Recommended Cements: Rely-X-Unicem 2 or Fuji Plus</p>

Fixed Prosthodontics Guidelines for Crowns

NO PORCELAIN
FULL ZIRCONIA (Monolithic (ALL) Zirconia)
FULL CAST CROWN (FCC, Full Gold Crown - FGC)
 Uniform 0.5mm chamfer all around / Functional cusp


Recommended Cements: RelyX-Unicem 2 or Fuji Plus



OCCLUSAL CLEARANCE:

FCC Occlusal: 1.5mm F + 1mm NF
 (more on mx molars)
 Margin: 0.5 chamfer - 360°

monoZIR Occlusal: **minimum of 1* mm**
 Margin: 0.5-1mm chamfer - 360°
 (thinner margin may cause chipping of pre-sintered zirconia)



TBX-PHD-2020

Classification -> StrengthA

FULL ZIRCONIA - MINIMUM OF 0.6mm THICKNESS
*(clinically, 1*mm occlusally and mid-axially)*

Lon TH et al. J Prosthet Dent. 2016 Jan;115(1):76-83.


"Zirconia prostheses with a minimal occlusal thickness of 0.7 mm had a high fracture resistance and the lowest stress values."

Nakamura et al. Acta Odontol Scand. 2015;73(8):602-8.

"The occlusal thickness significantly affected the fracture load, but the axial thickness did not. Monolithic zirconia crown with chamfer width of 0.5 mm and occlusal thickness of 0.5 mm can be used in the molar region in terms of fracture resistance."

Mark Denry Biomater Winter 2014 35(5):511-19

"Doubling the monolithic zirconia core from 0.6mm to 1.5mm increases the fracture resistance of this restorative system threefold."



THX-PRO2 2016

Total Occlusal Convergence

D-2 → avg. TOC of 15°
Seniors → avg. TOC of 22°+ (!)

Tsu J et al. Clinical tooth preparations and associated measuring methods: a systematic review. J Prosthet Dent. 2015 Mar;113(3):175-84.

HEIGHT & TAPER

Crown Height

TIX P1025 2016

TAPER, HEIGHT & RESISTANCE

Resistance Area (RA)

Typical Clinical Scenarios

short

over tapered

Bu, Li & Proximal Slots

Prousaefi P et al. The effectiveness of auxiliary features on a tooth preparation with inadequate resistance form. J Prosthet Dent. 2004 Jan;91(1):33-41.

Fixed Prosthodontics Guidelines for Crowns©

CAD PREP GUIDE
 (all ceramic, lithium (di)silicate)
 90 degree shoulder with rounded internal line angles

max anteriors
 lower incisors are smaller, margin depth - 0.75mm

premolars

molars

Recommended Cements: ALL CERAMIC - Multilink Automix (Ivoclar)
 LITHIUM DISILICATE - Relyx Unifast 2

Occlusal/Incisal Clearance:
minimum of 1.5 mm
 Margin: 1mm shoulder - 360°
 (all internal line angles rounded)

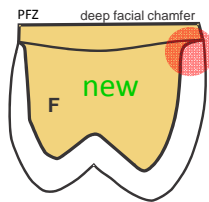
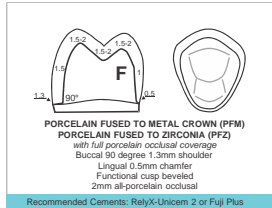
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Fixed Prosthodontics Guidelines for Crowns

Porcelain Fused to Zirconia

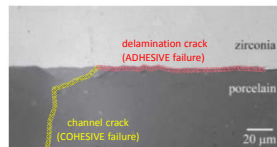
NO NEED FOR PORCELAIN SHOULDER
(zirconia is)

Instead, **deep facial chamfer**



TKK-PROS 2016

Zirconia Porcelain Chipping/Delamination – PFZ



Causes of porcelain chipping/delamination:

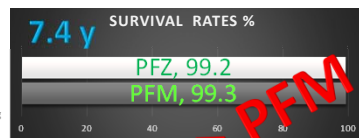
- Structural defects of zirconia
- Sintering problems
- Grinding flaws induced during lab procedures
- CTE mismatch between core and veneering materials
- Porcelain thickness (too thin or too thick - > 2mm)
- Sandblasting
- Framework (coping) design
- Fast cooling rates (!) - residual stresses from thermal processing

TKK-PROS 2016

PFM vs. PFZ

- 1102 PFZ and 1080 PFM
- Posterior bicuspid and molars
- One dental laboratory
- 1 porcelain (CZR Kuraray) and 3 ZR systems (Lava, Procera and Katana)

All post-cementation complications (e.g., porcelain fractures and chippings) were recorded as failures.



Coer, Fat et al. A retrospective survey on long-term survival of porcelain-brazirconite and porcelain-fused-to-metal crown in private practice. *Quintessence Int* (2014) No. 1 (11-12 2014).

Nathareon D. Chu², Yanyan Wu¹, H. Daniel Lee¹ **CF (2019)**, Performance of icon-based crowding and SPD in a road traffic scenario. *Accident Analysis and Prevention* 82:1–7. <https://doi.org/10.1016/j.aap.2019.03.009>



TKK-PROG 2016

the ideal ALL-CERAMIC crown ...

MONOLITHIC (preferred)

strength
&
esthetics

And ... minimalistic preparation

TRK-PRDS 2016

HIGHER TRANSLUCENCY
Fully Stabilized Zirconia
↑ cubic form zirconia

phase 1 MONOCLINIC ("m") ambient ↔ phase 2 TETRAGONAL ("t") 2140° F ↔ phase 3 CUBIC ("c") 4300° F

Obsidian®

Lithium Oxide 60%
Silicon Dioxide 20%
Zirconia 4%
Alumina 4%

LITHIUM SILICATE

TRK-PRDS 2016

Classification -> Strength -> Adjusting/Polishing

Monolithic Zirconia / Lithium Disilicate

phase 1 MONOCLINIC ("m") ambient ↔ phase 2 TETRAGONAL ("t") 2140° F ↔ phase 3 CUBIC ("c") 4300° F

	MOSTLY GLASS porcelain	GLASS-INFILTRATED lithium disilicate	POLYCRYSTALLINE zirconia
INTAGLIO ADJUSTMENT	NO	Ideally NOT, but...if so, then VERY carefully (low speed + fine diamonds + lots of water)	Ideally NOT, but...if so, then VERY carefully (low speed + fine diamonds + lots of water)
INTAGLIO SANDBLASTING	NO	YES (≤ 50µm alumina, 10 psi)	YES (≤ 50µm alumina, 10 psi)

* INTAGLIO ADJUSTMENTS INCREASE THE RISK OF CREATING LARGE DEFECTS AND FUTURE CATASTROPHIC FAILURE.

** (Gentle) sandblasting of zirconia (Y-TZP → Yttria-stabilized Tetragonal Zirconia Polycrystal) will increase its toughness through stress transformation (3-4% volume expansion of monoclinic particles close to the fracture tip – crack (tip) shielding by compression).

*** Heat treatment after grinding/sandblasting drops strength by 30%
Polishing promotes reverse m -> t like heat but decreases size of surface flaws and improves flexural strength.

TRK-PRDS 2016

Classification -> Strength -> **Adjusting/Polishing**

Monolithic Zirconia / Lithium Disilicate

Adjustment with diamonds at SLOW speed with copious irrigation

Polished zirconia wears opposing enamel LESS than glazed zirconia



McLaren EA, et al. *Inside Dentistry*; Nov 2015;11(3).
 "The Dialite LD Extra-Oral Polisher System was tested and found to be extremely effective ... for zirconia and lithium disilicate crowns ..."

TRX-PHDS 2016

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Home » Why are crowns coming off?

Why are crowns coming off?

September 30, 2015



ALL-CERAMIC

MOSTLY GLASS

feldspathic

GLASS INFILTRATED

lithium disilicate (*E.max*®)

POLY-CRYSTALLINE

zirconia based
layered
monolithic (*BruxZir*®)

TRX-PHDS 2016

**COMPROMISED
PREPARATION GEOMETRY**

&

**INCORRECT CEMENTATION
SEQUENCE**

TRX-PHDS 2016

Classification -> Strength -> Adjusting/Polishing -> **Bonding + Luting**

CEMENTATION { **Bonding = chemical union**
Luting = physical seal

In case of good preparation design (resistance and retention form) AND strong crown, luting is enough.

If glass is a small component, AND preparation is good, then bonding is NOT necessary.

TRK-PHDS 2016

Classification -> Strength -> Adjusting/Polishing -> **Bonding + Luting**

LUTING SEQUENCE (GC)

AFTER CHECKING FIT, OCCLUSION, ADJUSTING & POLISHING		ALL CROWNS
STEP 1 : SANDBLAST Intaglio / CLEAN	≤ 50 µm Al2O3 at low pressure and 10mm distance (1 bar for 15 sec) Use IVOCLEAN for intaglio in zirconia crowns	
STEP 2 : TOOTH PREPARATION	a) Clean the prepared tooth with pumice and water. b) Use GC Fuji PLUS CONDITIONER on the prepared tooth surface for 20 seconds for optimal adhesion. c) Rinse thoroughly with water. Remove excess moisture by blotting with a cotton pellet or gently blowing with air. DO NOT DESICcate. Prepared surfaces should appear moist (glistening).	
STEP 4 : CEMENT	Resin GI – GC Fuji PLUS	

Advantage → Dentin bonding AND preventive potential through fluoride / REMOVAL
Problem → Potential sensitivity due to pH drop during initial setting

TRK-PHDS 2016

Classification -> Strength -> Adjusting/Polishing -> **Bonding + Luting**

CEMENTATION { **Bonding = chemical union**
Luting = physical seal

In case of good preparation design (resistance and retention form) AND strong crown, luting is enough.

If glass is a small component, AND preparation is good, then bonding is NOT necessary.

Otherwise, if material is porcelain and/or preparation is COMPROMISED, then ALWAYS BOND!

TRK-PHDS 2016

Classification -> Strength -> Adjusting/Polishing -> **Bonding + Luting**

BONDING SEQUENCE (Ivoclar / 3MEspe)

AFTER CHECKING FIT, OCCLUSION, ADJUSTING & POLISHING	MOSTLY GLASS & GLASS-INFILTRATED (porcelain, lithium (di)silicate)	POLYCRYSTALLINE (alumina, zirconia)
STEP 1 : SANDBLAST Intaglio	≤ 50 µm Al2O3 at low pressure and 10mm distance (10 psi for 15 sec)	≤ 50 µm Al2O3 at low pressure and 10mm distance (10 psi for 15 sec). OPTION: Use silica-modified 30µm Al2O3 (soft ROCATEC, CoJet)
STEP 2 : ETCH / CLEAN Intaglio	20 second etch with 5% HF – wash & dry	NO ETCH – <u>use Ivoclean (zirconia suspension)</u>

TUX-PHOS 2016

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Home » Why are crowns coming off?

Why are crowns coming off?


Blood, mucus, and other liquid debris are always present on the internal surfaces of restorations after the trial seating to evaluate fit, color, contacts, and occlusion.

Place liquid phosphoric acid on the internal surfaces of restorations to remove the organic debris before seating and wash the internal surfaces well with water to remove the acid.


DO NOT DO THIS! The formed Zirconium phosphate renders the intaglio surface INERT to the primer.

Roughening the internal surfaces of zirconium oxide restorations before seating them is not a good idea because of the potential of producing micro cracks in the zirconium oxide.

TUX-PHOS 2016



Zirconia




Phosphates

TUX-PHOS 2016

During try-in, the phospholipids from the saliva react with zirconia and form zirconium phosphate which renders intaglio inert to the primer. 😞

By cleaning intaglio with a HIGH concentration of zirconium particles, the phosphate contaminants are absorbed and removed from the intaglio surface. 😊



Classification -> Strength -> Adjusting/Polishing -> **Bonding + Luting**

BONDING SEQUENCE (Ivoclar / 3MEspe)

AFTER CHECKING FIT, OCCLUSION, ADJUSTING & POLISHING	MOSTLY GLASS & GLASS-INFILTRATED (porcelain, lithium (di)silicate)	POLYCRYSTALLINE (alumina, zirconia)
STEP 1 : SANDBLAST Intaglio	≤ 50 µm Al ₂ O ₃ at low pressure and 10mm distance (1 bar for 15 sec)	≤ 50 µm Al ₂ O ₃ at low pressure and 10mm distance (1 bar for 15 sec). OPTION: Use silica-modified 30µm Al ₂ O ₃ (soft ROCATEC, CoJet)
STEP 2 : ETCH / CLEAN Intaglio	20 second etch with 5% HF – wash & dry	NO ETCH – use Ivoclean (zirconia suspension)
STEP 3 : CONDITION w/ single-component bonding agent	Monobond PLUS (60 sec) – dry (3 methacrylates – silane, phosphoric, sulfide)	Monobond PLUS (60 sec) – dry (3 methacrylates – silane, phosphoric, sulfide)
STEP 4 : CEMENT	RRGI – Relyx Unicem II / Ultimate Multilink Automix	RRGI – Relyx Unicem II / Ultimate Multilink Automix

T16-P1025 2016

Classification -> Strength -> Wear -> Adjusting/Polishing -> **Cementation** -> Removal

Monolithic Zirconia / Lithium Disilicate

- Luting (physical) & Bonding (chemical)

(KURARAY)

1. Sandblast intaglio with ≤ 50 µm Al₂O₃ at low pressure (1-2 bar for 15 sec)
2. Sandblast with silica-modified 30µm Al₂O₃ (soft ROCATEC)
3. Apply Clearfil Ceramic Primer Plus (KURARAY) to intaglio - (no HF, any all-ceramic, no mixing, contains **MDP** adhesive phosphate AND **silane** monomers) – **MDP = 10-Methacryloyloxydecyl dihydrogen phosphate**
4. Apply Clearfil Tooth Primer (KURARAY) intraorally
5. Apply luting medium (resin cement) **PANAVIA VS** (KURARAY)

(IVOCLAR or 3M Espe)

1. Sandblast intaglio w/soft ROCATEC
2. Apply IVOCLEAN (zirconia suspension)
3. Apply Monobond PLUS (3 methacrylates – silane, phosphoric, sulfide) – disperse with air only.
4. Apply luting medium (resin cement) **MULTILINK AUTOMIX OR RelyX Unicem II** or Ultimate (3M Espe)

Bonnickle W et al. Durability of Resin-Zirconia Bonds Produced Using Methods Available in Dental Practice. J Adhes Dent. 2016 Jan 26; doi: 10.3290/jad.a35517. [Epub ahead of print]

3. Describe the advantages and limitations in using newer all-ceramic materials for FDP.

ADVANTAGES:

- ✓ Esthetics
- ✓ Strength (minimum thickness)
- ✓ Wear (thermocycling, multiaxis dynamic simulation)

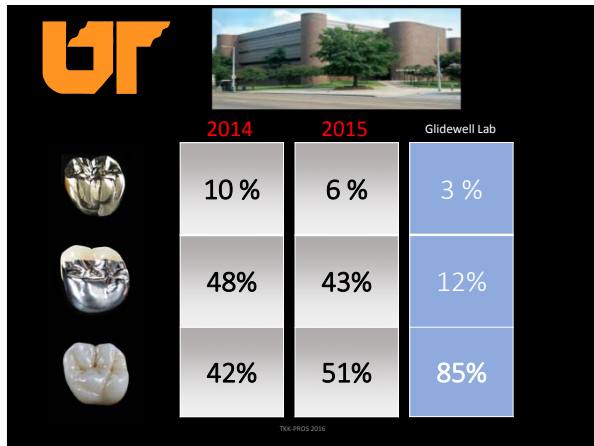
ZIRCONIA SHORTCOMINGS:

- Too much grinding without coolant will create defects that lead to catastrophic structural flaws (overcomes compression layer in “m” phase). Due to aging, water penetrates pre-existing defects that enlarge over time also with catastrophic result (Low Temperature Degradation or LTD) Solution: Zirconia-toughened alumina (ZTA)
- Technique sensitive cementation if geometry is less than ideal.
- Limitation of intraoral zirconia crown alteration for a partial.
- Attachments.
- Very difficult to remove if bonded (e.max® + bruxzir®)

(Erbium laser → Dr. Walinski)

T16-P1025 2016





"SO YES, GOLD AND PFM ARE STILL ALIVE"

THE UNIVERSITY OF
TENNESSEE
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