What material do I use?


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Confusion sometimes exists with some clinicians regarding the choice of materials to employ in clinical situations. This summary article outlines guidelines for various materials available and preparation principles. The underlying composition of dental ceramics determines their physical properties which will, accordingly, dictate their suitability for any given clinical situation. Consider dental ceramics as a spectrum with an unfilled glassy matrix at one end and a virtually wholly crystalline structure with little if any matrix at the other end.

FELDSPATHIC CERAMICS (Glass Matrix)

These are largely vitreous or glass ceramics, with 3D networks of atoms having no regular pattern to the spacing and characterised by an amorphous structure.

GLASS-BASED CERAMICS (Filled particles)

Filler particles are added in increasing amounts to the base glass matrix to improve mechanical properties and to control optical effects such as opalescence, colour and opacity. The first fillers to be used contained particles of a crystalline mineral called leucite. This was added by simply mixing in the filler ceramic (between 17-25% mass). The porcelains created could be fired successfully onto metal substructures. An alternative approach is where the filler particles are grown inside the basic glass restoration after it has been formed. In one approach, the glass is given a special heat treatment (ceraming), causing the precipitation and growth of the crystals within the glass. The fillers are derived chemically from atoms of the glass itself.

Examples of glass-based ceramics include IPS e.max®, IPS e.max® ZirPress and Vita Suprinity®.

IPS e.max® is a 70% lithium disilicate glass ceramic which offers:

- optimised translucency – light diffusion properties
- pleasing aesthetics
- superior durability (470-530 MPa flexural strength)
- strength for full anatomical restorations
- opalescence
- option of monolithic (solid) aesthetic restorations using CAD, or layered/veneered restorations for optimum aesthetics

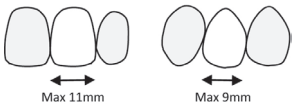
Clinical Tip for use of IPS e.max®:

- Crowns – anterior & premolar
- Inlays/onlays
- Veneers
- Anterior implant crowns
- Anterior 3-unit bridges (include premolar) – Use Press ONLY

Clinical Tip for IPS e.max® Bridges

In the anterior region (up to canine) the pontic width should not exceed 11mm. In the premolar region (canine to second premolar) the pontic width should not exceed 9mm.

Bridges of more than 3 units or those in the premolar to molar region should instead be fabricated as IPS e.max® ZirPress.



Clinical Tip for IPS e.max® ZirPress

Consider using IPS e.max® Ceram pressed over zirconium oxide substructures for patients with bruxism or where the span length or tooth size prevents ideal use of IPS e.max®. The porcelain used can be matched to adjacent IPS e.max® crowns. When stump shade is dark, consider using a more opaque ingot. There are different values and hues of the ingots. Allow adequate preparation depth for the zirconia structure and overlying porcelain.

Suitable for:

- Single-tooth restorations
- Bridges in the anterior and posterior region
- Implant superstructures

VITA SUPRINITY® is a millable lithium silicate glass ceramic with 10% zirconia.

MATERIAL CLASS		**Glass Ceramic**		
Composition		Leucite Glass Ceramic	Lithium Silicate with 10% Zirconia	Lithium Disilicate Glass Ceramic
Example		IPS Empress® Esthetic	Vita Suprinity® Celtra® Duo	IPS e.max® (CAD or Press)
PROPERTIES	Flexural Strength (MPa)	160	360-500	CAD 530 Press 470
	Number of shades	12	8	20
	Aesthetics / Translucency	✔✔✔✔✔ (able to be layered)	✔✔✔✔	✔✔✔✔✔ (able to be layered)
INDICATIONS				

HIGH-STRENGTH CRYSTALLINE CERAMICS

Polycrystalline ceramics contain densely packed atoms with little or no vitreous glassy 'matrix' phase.

Polycrystalline ceramics are more opaque and more difficult to process into complex shapes than glass ceramics. Computer-aided manufacturing (CAM) has allowed well-fitting prostheses made from polycrystalline ceramics to become possible. Zirconia is the commonest example of polycrystalline ceramics and can be either monolithic (unlayered or "fully milled") or layered with a veneering ceramic, which is called porcelain-fused-to-zirconia (PFZ).

A. MONOLITHIC FULLY MILLED ZIRCONIA (FMZ)

Considerations when using Monolithic Zirconia:

- FMZ crowns can readily mask out discoloured, non-vital teeth where sufficient tooth preparation exists of at least 0.6 mm.
- Thicknesses greater than that are far too opaque for upper anteriors.
- Overpreparation of teeth is contraindicated when using monolithic zirconia as there is no need to create room for veneering porcelain.

FMZ restorations are coloured utilising a three-zone colouring system while in the unsintered state:

The restoration is brushed with the final shade around the cervical area.

The desired body shade is then applied.

Effect shades are finally added to the occlusal aspect.

Indications	Contraindications
Bridges for posterior teeth where exquisite aesthetics are not paramount.	High aesthetics
Metal-free options are preferred.	Exposed dentine on the antagonist preoperatively
Bruxers where: PFM metal occlusal or full cast crown is undesirable. The antagonist is metallic or zirconia.	Short clinical crown (limited bonding surface for micromechanical retention)
Limited interocclusal space	Using an FMZ crown to replace a PFM may result in a high value crown due to the thickness of the axial walls of the PFM preparation.
	Possible endodontics
	Post-insertion occlusal adjustment

Clinical Tips for Zirconia Restorations

1. With adequate connector size, 3-, 4- and even 6-unit bridges are very dimensionally predictable. Consider "closed" embrasures in the design to allow sufficient connector bulk.
2. After trying-in the restoration and checking fit and occlusion, the fitting surface needs to be disinfected then cleaned to remove all contaminants. This can be achieved with Ivoclean™ although sandblasting with up to 50 micron abrasive is also effective (Powers, J.M., et al., 2009). The restoration should then be rinsed and dried.
3. Zirconia should never be etched as this will impair bonding especially where phosphoric acid is used.

UZir Ultra Translucent is a new formula of zirconia, offering a unique combination of translucency and strength. This product is a breakthrough given that traditionally zirconia is considered a strong but opaque material with questionable aesthetics in anterior regions. The strength of UZir is higher than more translucent alternatives and so it addresses the market in between glass ceramics and the more opaque crystalline zirconias. Multi-layered blocks enhance aesthetics without compromising strength by layering.

Translucency is similar to IPS e.max®.

Clinical Tip for UZir:

Consider ultra translucent zirconia for cases where strength and resistance to chipping are required in combination with good aesthetics.

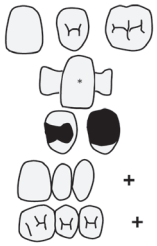
Suitable for anterior crowns, inlay/onlays and other single unit restorations, some posterior crowns.

B. PORCELAIN-FUSED-TO-ZIRCONIA

- Used as a more aesthetic option than monolithic zirconia.
- Zirconia forms the framework material for anterior and posterior crowns and bridges, with veneering porcelains applied over all or part of this zirconia core.
- Veneering porcelains have evolved with fine microstructures with improved optical properties and clinical performance. They are more translucent and generally produce excellent aesthetics in 0.6 mm thickness (over a 0.6 mm zirconia coping) meaning a reduction of at least 1.2 mm is critical.
- More tooth preparation is needed than for FMZ to allow room for veneering porcelain.

Clinical Tip

Core bulk fractures in bridges with PFZ or monolithic zirconia are most commonly located in the connector region and start from the gingival surface upward where the tensile forces are greatest due to occlusal loading.

MATERIAL CLASS		Monolithic Zirconia (Zir)		Veneered Zirconia	
Composition		Zir – Ultra translucency	Zir – High strength	Zirconia with leucite veneer	Zirconia with IPS e.max® veneer
Example		U-Zir®	FMZir (Fully Milled Zirconia)	PFZ	IPS e.max® ZirPress/ ZirCAD
PROPERTIES	Flexural Strength (MPa)	557	1200	90 (porcelain) 1200 (base)	120 (porcelain) 1200 (base)
	Number of shades	20	12	8 framework shades	8 framework shades
	Aesthetics / Translucency	✓✓✓✓	✓✓✓	✓✓✓	✓✓✓
INDICATIONS					

Legend + = longer spans possible

METALS

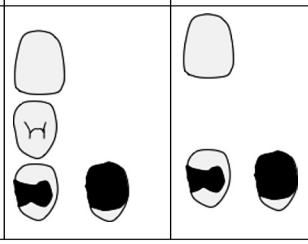
Indications for use of gold in dentistry	Contraindications
inlays/onlays/overlays	Aesthetics
dowels, post and cores (Type 2, 3 and 4 gold alloys)	Extensive cavities
partial crowns, full crowns, telescopic crowns	Bruxism – uncontrolled
bridges	Short crowns
removable dentures	Thin walled cavities
implant-supported overdentures with bar joints	

METAL-CERAMICS (Porcelain-Fused-To-Metal)

Advantages of PFM	Disadvantages of PFM
Strength	Amount of tooth preparation
Marginal integrity	Pulpal health
Aesthetics	Colour stability
High bond strength of ceramic to metal	Tooth wear
Posterior full-coverage cases – allow versatility e.g. stress-breaker	Opacity

HYBRID CERAMICS

These are considered "high performance polymers". The materials are composite materials which contain either ceramics, nano-ceramics or glass combined with different resin components. They can be used for either temporary or permanent restorations. Commonly used materials are CERAMAGE® and Enamic®.

MATERIAL CLASS		Hybrid Ceramic	
Composition		Zirconium silicate	Inorganic ceramic matrix 86% filled with 14 % organic polymer
Example		CERAMAGE®	Enamic®
PROPERTIES	Flexural Strength (MPa)	140	150-160
	Number of shades	Extensive	Extensive
	Aesthetics / Translucency	✓✓✓	✓✓✓
INDICATIONS			

INLAYS AND ONLAYS

Main options for intracoronal posterior aesthetic restorations

Indirect ceramics	preserve tooth structure
Indirect hybrid composite	produces quality, durable restorations (Barone, A., et al., 2008). are superior to direct composites because the bulk of polymerisation shrinkage takes place extraorally so there is less stress at the tooth-restoration margin.

SUGGESTED PREPARATION FEATURES FOR CROWNS

Evaluate:

- Coronal support
- Axial wall preparation – Two-plane buccal reduction of anterior teeth
- Tooth reduction on incisal/occlusal surfaces – even reduction, depth grooves
- Tooth form – ensure circumferential irregularity
- Total occlusal convergence – ideal TOC should be between 10-22°
- Tooth height – anterior teeth 5 mm; posterior teeth 4 mm
- Margin design – NO knife edge margins for all-ceramic restorations

	Reduction	Finish Line Depth & Configuration
ANTERIOR CROWNS		
All-Ceramic (veneered or monolithic) IPS e.max® or IPS Empress	2.0mm incisally 1.0mm buccal/lingual	0.8-1.0mm shoulder
Porcelain-fused-to-zirconia	2.0mm incisally 0.6-1.0mm lingual aspect (Porcelain guidance requires greater clearance)	>0.4mm chamfer lingually >1.0mm labial
Metal-ceramic (Porcelain-fused-to-metal)	2.0mm incisally 0.5-1.0mm lingual aspect (Porcelain guidance requires greater clearance)	1.5mm labial shoulder or heavy chamfer 0.5mm lingual chamfer 1.5mm circumferentially for 360° ceramic margin
POSTERIOR CROWNS		
Full contour crowns (metal or zirconia)	1.0mm non-functional cusps 1.5mm functional cusps	0.3-0.5mm shoulder or heavy chamfer
All-ceramic (veneered or monolithic) IPS e.max® or IPS Empress Esthetic® **Porcelain-fused-to-zirconia**	2.0mm non-functional cusps 2.5mm functional cusps	1.0mm shoulder or heavy chamfer
Metal-ceramic (Porcelain-fused-to-metal)	If metal occlusal, as with FCC 2.0mm non-functional cusps 2.5mm functional cusps	1.5mm labial shoulder or chamfer 0.5mm lingual chamfer (metal collar) 1.5mm circumferentially for 360° ceramic margin