Materials and adhesion

When and where do we place ceramics

What is the composition of dental ceramics

What are the different types of ceramics

What are the properties of dental ceramics

What are the different ceramic treatment options

What are the classifications of dental ceramics

JR

Materials and adhesion

Conventional dental porcelain

Advantages

Dimensional stability

Low solubility in oral fluids

Excellent color matching

Tissue tolerance

High wear resistance

Ability to etch and bond

Disadvantages

Can be abrasive to opposing

Fabrication can be complex

Intra-oral finishing difficult

Low fracture resistance

Needs to be supported!!!!

JR

Materials and adhesion

Factors determining which ceramic to use

Clinical condition

Dentist's knowledge and experience

Technician experience

Dentist's trust in newer materials

What systems are available in the lab

Patient's expectations: i.e. esthetics vs. longevity vs. clinical history

JR

Materials and adhesion

Properties of feldspathic porcelain

Esthetics can be excellent

Fit can be excellent

Etchable and bondable

Flexural strength of 80-125 MPa

Various levels of hue, value, chroma

Once finished, adjustments are not practical

Thermal conductivity similar to teeth

JR

Materials and adhesion

Properties of feldspathic porcelain

Thermal conductivity similar to teeth

Expansion similar to dentin and enamel

Small particle size of porcelain has a wear compatibility similar to enamel

Power-liquid technique allows for placement of porcelains in specific areas to create special effects

Materials and adhesion

Properties of strengthened glass ceramic (E-max)

More translucent than zirconia

Micro-cracks maybe problematic

Wide range of indications

Various colors

Can be cutback and layered

Can be pressed or milled, e.g. e-max

JR

Materials and adhesion

Properties of strengthened glass ceramic (E-max)

Etchable, i.e bondable or cementable!

Flexural strength high, 350-500+MPa

Thermal conductivity similar to tooth

Not for posterior bridges or >3 unit anterior bridges

Expansion coefficient similar to dentin and enamel

Radiolucent!

JR

Materials and adhesion

Properties of zirconia (Lava)

Expansion coefficient similar to dentin and enamel

Zirconium oxide contains metal ions, radiopaque!

Can be layered with feldspathic, pressed or milled ceramics

Various color between systems

Esthetic monolithic variations available!

Chemically unreactive in the mouth

Materials and adhesion

Properties of zirconia (Lava)

Expansion coefficient similar to dentin and enamel

Zirconium oxide contains metal ions, radiopaque!

Can be layered with feldspathic, pressed or milled ceramics

Various color between systems

Esthetic monolithic variations available!

Chemically unreactive in the mouth

JR

Materials and adhesion

Properties of full contour zirconia (Bruxir)

Expansion coefficient similar to dentin and enamel

Translucency varies between systems, but radiopaque!

Can be layered with feldspathic porcelain

Various color between systems

Esthetic monolithic variations available!

JR

Materials and adhesion

Properties of full contour zirconia (Bruxir)

Non-etchable

Flexural strength high, 700-1100+MPa

Thermal conductivity similar to enamel

Microcracks possible

Viable for long spanned bridges

JR

1 - if cut backed and layered with feldspathic porcelain

Materials and adhesion

	Ceramics	Strengthened Ceramics		Zirconia
	Feldspathic	Pressed	Milled	High/low translucency
Veneers	+++	+++ 1	++ 1	X
Inlay/Onlay	++	+++	+++	+
Ant. Crown	++	+++ 1	+++ 1	++1
Post. Crown	X	+++ 1	+++ 1	+++ 1
Ant. Bridge	X	+++ 1	+++ 1	++1
Post. Bridge	X	++ 1	++ 1	+++ 1
Implant	X	+++ 1	+++ 1	+++ 1

JR

Do not be too heroic!

Remember that the various ceramic materials are not better then what nature gave us!

Make sure the design addresses any anterior or posterior occlusal interferences that can precipitate ceramic fracture along with analyzing existing wear patterns!

Laboratory considerations

Obstacles and Objectives

- Laboratory experience, talent and skillset
- Laboratory equipment and materials
- Proximity of the laboratory to the office
- Communication: clinical condition, expectations
- Reasonable turn around time
- Understanding manufacturing options
- Expenses

Laboratory considerations

Necessary information

- Detailed lab prescription (analog/digital)
- All necessary photography (pre, stump, prep)
- Computer simulation
- Template design
- Impressions (analog/digital)
- Bite registration (analog/digital)
- Facebow (analog/digital)
- Model and pictures of accepted provisionals

JR

Laboratory considerations

Manufacturing options

Layering - feldspathic porcelain

Pressing - strengthened glass

Milling - zirconia/strengthened glass ceramic

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Laboratory considerations

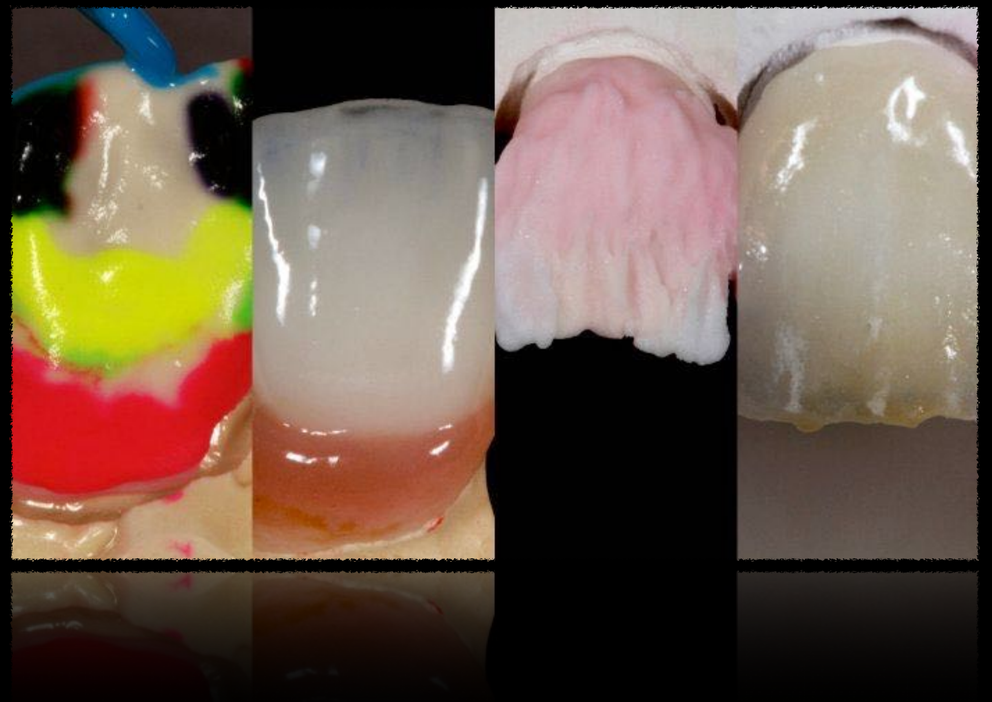
Layering

utilizing feldspathic porcelain

time consuming

can be expensive

best esthetics



can be used alone or with a cutback and layer technique

JR

Laboratory considerations

Pressing

utilize lost wax technique

utilizing strengthened glass ceramics, e.g. lithium disilicate

can be less expensive than conventional layering and firing

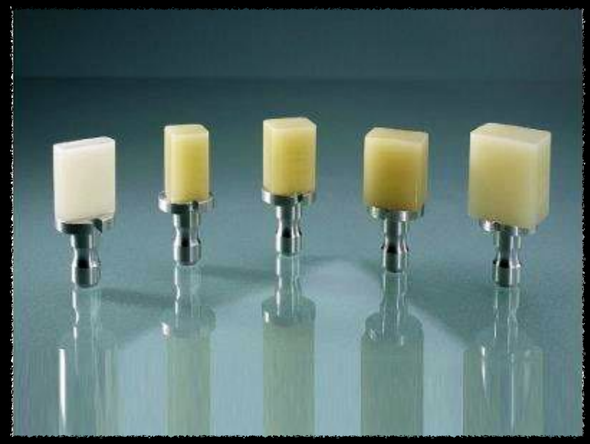
Jr

best esthetics if cutback/layered, but can also surface stain

JR

Laboratory considerations

Milling



utilizing “pucks” or “blocks”

strengthened glass ceramic - milled in a couple of hours

zirconia - needs sintering so completion takes several hours

chair side or lab - need equipment, e.g. milling unit, oven, etc.

can be generated with or without a model

JR

Laboratory considerations

Milling

dry mill - zirconia/PMMA/wax

wet milling - glass ceramic/composite/zirconia

least expensive option, particularly if done modelessly

minimal human input - extremely accurate, adjustments rare

Laboratory considerations

Veneer manufacturing options

Conventional Refractory die or platinum foil utilizing feldspathic porcelain

Pressed Strengthened ceramics cut back and layered or surface stained

Milled Strengthened ceramics cut back and layered or surface stained

Laboratory considerations

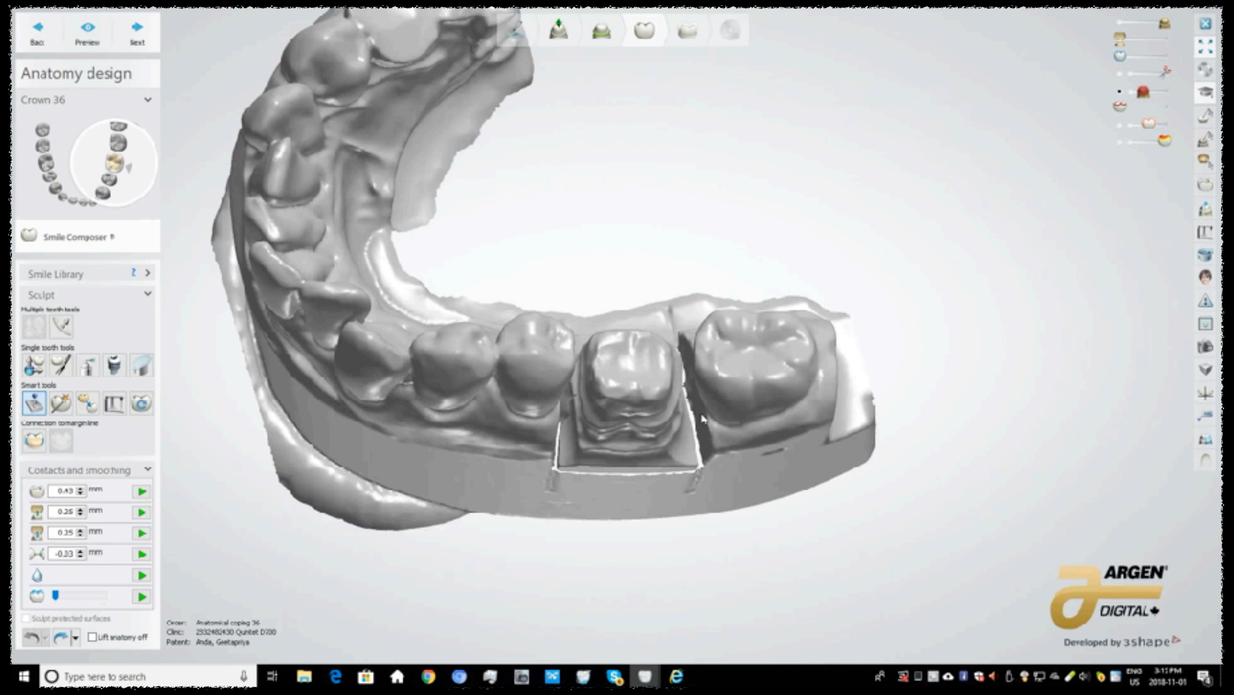
Veneer manufacturing options

Conventional Preferred option for minimally prepared teeth

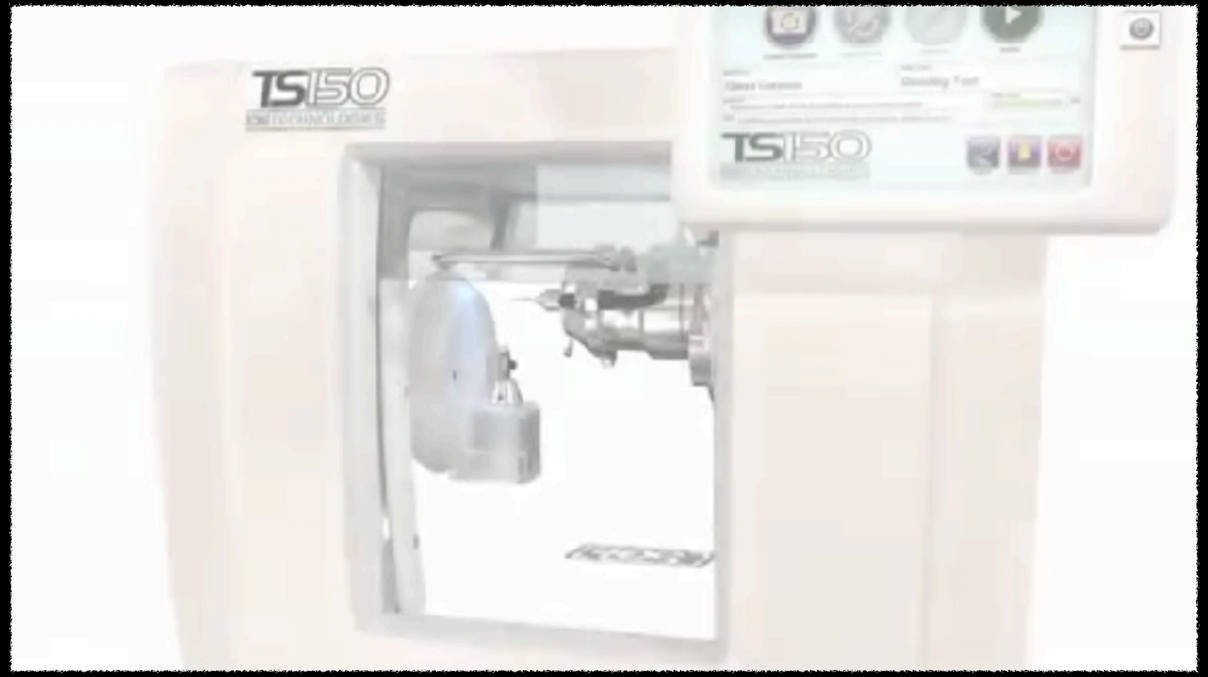
Pressed Preferred option for preparations that are into the dentin

Milled Preferred option for preparations that are into the dentin

Digital design



Milling



JR

The traditional workflow for creating posterior ceramic restorations

Tooth is prepped

↓

Analog impression taken

↓

Prototype crown made

↓

Case shipped to the lab

↓

Stone model fabricated

↓

Restoration hand made

↓

Case shipped

↓

Restoration cemented

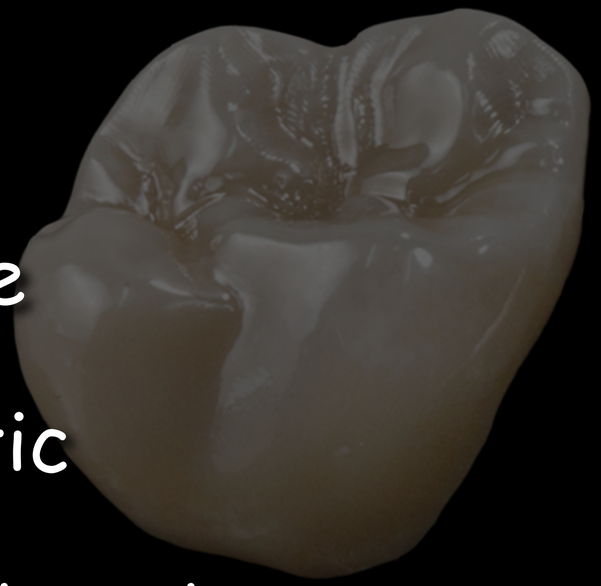
Positives

Long track record

Can be very accurate

Can be highly esthetic

Can address all treatments



Negatives

Several steps

Expensive

Time consuming

Technician dependent

“Human errors!”

The digital workflow for creating posterior ceramic restorations

Laboratory manufactured

Tooth is prepped

↓

Digital impression taken

↓

Prototype crown made

↓

Case electronically sent

Model less design created

↓

Computer milled restoration

↓

Case shipped

↓

Restoration cemented

JR

The digital workflow for creating posterior ceramic restorations

JR

Chairside manufactured

Tooth is prepped

↓

Digital impression taken

↓

Model less design created

↓

Restoration chairside milled

↓

Restoration cemented

JR

Model less design created

↓

Restoration chairside milled

↓

Restoration cemented

Positives

Extremely accurate

Adjustments rare

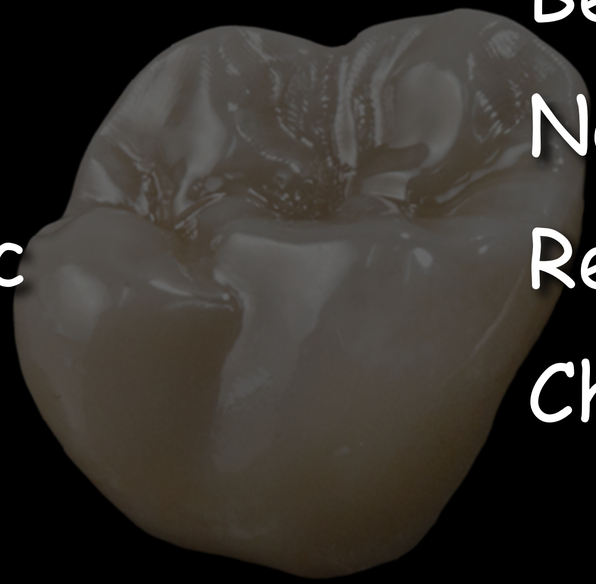
Can be very esthetic

Inexpensive

Model less

Efficient

Fewer “Human errors!”



Negatives

Best for single units

New learning curve

Requires scanners

Chairside miller?

Cementation fundamentals

Cementation fundamentals

Technology Level

- Self-Adhesive Resin
- Adhesive Resin
- Resin-modified GI
- Glass Ionomers
- Polycarboxylates
- Zinc Phosphates

Technology Level

Cementation fundamentals

Substrates

Metal/PFM:

- Inlays/Onlays
- Crowns
- Bridges
- Endodontic posts

Strengthened Core Systems:

(e.g. Lava, Procera)

- Crowns
- Bridges

Ceramics/Zirconia:

(e.g. Emax, Bruxzir)

- Crowns
- Bridges
- Inlays/onlays
- Veneers*

Composite/Polymer:

- Crowns
- Inlays/Onlays
- Bridges

JR

Cementation fundamentals

Mechanical - acid etching with HF (9.5%)

Works only on silica based ceramics

Feldspathic porcelain: 2-3 min. w/9.5% HF

Leucite reinforced glass ceramic: 1 min. w/ 5% HF, e.g. Empress (Ivoclar)

Lithium disilicate reinforced glass ceramic: 20-30 sec. w/ 5% HF, e.g. Emax (Ivoclar)

Resin adhesion to ceramics

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Cementation fundamentals

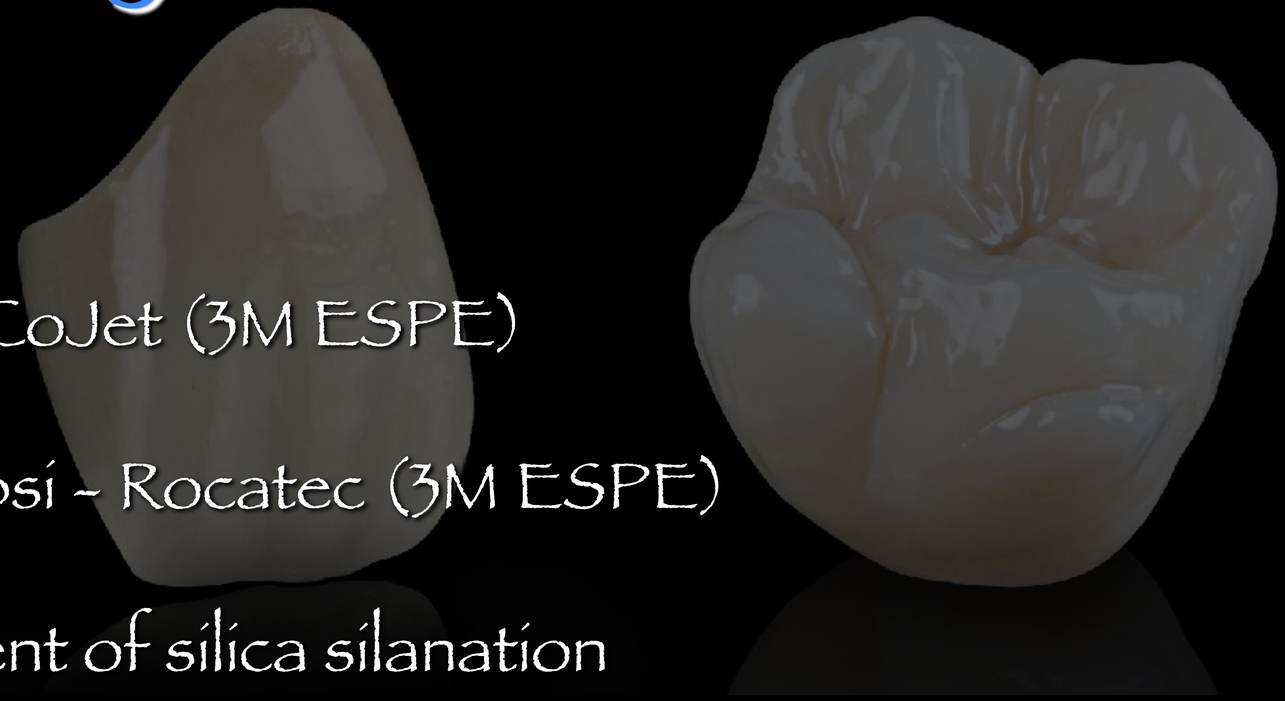
Mechanical - sandblasting

50 µm Al_2O_3 @ 30 psi

30 µm silica-modified Al_2O_3 @ 30 psi - CoJet (3M ESPE)

110 µm silica-modified Al_2O_3 @ 60-100 psi - Rocatec (3M ESPE)

Roughening and deposition/embedment of silica silanation



Cementation fundamentals

Silanes

Coupling agents for resin/ceramic adhesion only!

Improved wetting of ceramic surface by resin

Bi-functional molecules

Activation with acid required

Not utilized on tooth structure!

Cementation fundamentals

Conventional adhesive cements

JR

Cementation fundamentals

Self-etching adhesive resin cements

JR

Cementation fundamentals

Ceramics...

Do

Clean the restoration to remove contamination which inhibits resin bonding,
e.g. 37% phosphoric acid, air abrasion

Do

Etch porcelain for 2 minutes, e.g. 9.5% hydrofluoric acid

Etch lithium disilicate for 20 seconds, e.g. 5% hydrofluoric acid

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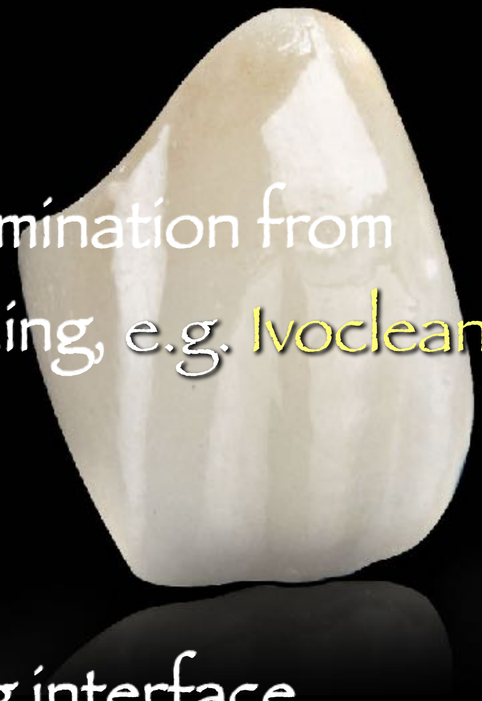
Cementation fundamentals

Zirconia...

Do

Clean the restoration to remove contamination from phospholipids which inhibit resin bonding, e.g. Ivoclean



Do

Use a primer to facilitate resin bonding interface

e.g. MDP (10-methacryloyloxydecyl dihydrogen phosphate)

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Cementation fundamentals

Zirconia/ceramic (C&B/Inlay/Onlay)

Conventional and resin-based cements can be used

Where higher translucency, shaded cements may help?

Recommended Cement Systems

Self-Adhesive Resin Cement, e.g. Rely X Unicem

Resin-Modified Glass **Ionomers**

Glass Ionomer Luting Cements

Dual-Cure Resin Cements

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Cementation fundamentals

Conventional porcelain laminates

Resin luting cements required

Pre-treatment requires, i.e. etching tooth and veneer

Due to higher translucency, shaded cements may help?

Do not use dual cure resin cement systems

Recommended Cement Systems

Rely X veneer cement, Calibra, etc.

JR

Cementation fundamentals

Veneering resin cements

JR

Cementation fundamentals

Veneer bonding materials

adhesive system

37% phosphoric etch

porcelain finishing kit

light cure resin cement

curing light

10 workflow modules to master comprehensive esthetic therapy

Diagnostics, smile design and tx plan

Interdisciplinary communication

Tooth preparation and design

Impression techniques

Prototype restorations

Materials and adhesion

Laboratory considerations

Cementation fundamentals

Maintenance

Marketing strategies

JR

Maintenance

Maintenance

Maintaining tissue health and ceramic integrity

Respect the "4 R's"

Responsibility for biological health

Reassure ceramic integrity and longevity

Respect the patient's investment

Reap the potential marketing benefits

JR

Maintenance

Marginal seal and the sulcus... the weak links

- Healthy gingival tissue
- Correct emergence profile
- Properly contoured restorations
- Excellent hygiene

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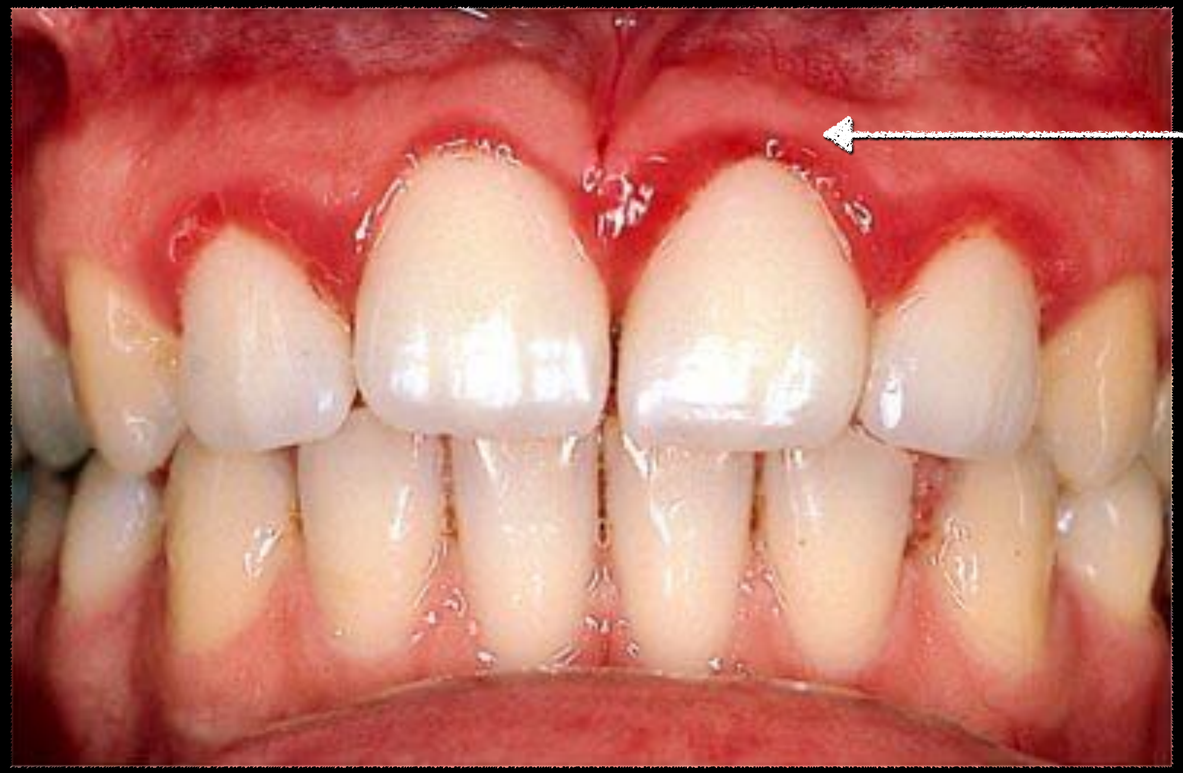
Maintenance

Marginal seal and the sulcus... the weak links



- Significant inflammation
- Incorrect emergence profile
- Poor contours
- Poor hygiene

Therefore... JR

Maintenance

Health and longevity will be based on:

Polished and properly contoured ceramics

Attention to the details regarding the bonding protocol for the ceramics

Meticulous removal of any excess cements or resins

Using mechanical and chemical products to keep the margins and sulcus clean

Utilizing the correct techniques with any cleaning products, eg flossing or brushing

Minimizing excessive acidic or abrasive exposure to the ceramics

Maintenance

What is the longevity of restorations?

Dependent on operator skill and experience

Dependent on laboratory skill and experience

Dependent on thorough diagnosis, e.g. occlusal considerations

Dependent on the patient's maintenance, as well as use and abuse

Pre-op 2005 2023

15+ years, assuming above factors are met!

JR

Maintenance

What are the do's and don'ts?

What to use for maintenance?

How to maintain ceramic integrity?

What is the longevity of ceramics?

Questions?

JR

Maintenance

What are the do's and don'ts?

Do's

Do - be conscientious with your hygiene

Do - use aids designed in maintaining ceramics/resins

Do - have regular check-ups with your dentist

Do - use ADA approved cleaning products

Do - wear your prescribed "nightguard"

Don'ts

Don't - use teeth as tools, e.g. don't open beer bottles with your teeth

Don't - chew or crunch ice!

Don't - expose ceramics to excessive acidic products

Don't - expose ceramics to excessive staining foods or liquids

Don't - smoke!

JR

Maintenance

How to maintain ceramic integrity?

Influencing factors to consider

Ceramics, though dense, are water soluble over time

Dentistry does not have a "perfect" marginal seal between tooth and restoration

Exposure to temperature changes, acids, bacteria and occlusal forces

Patient's behavior and habits