Posterior prototype restorations

Temp cement placed in the prototype, e.g TempoCem ID

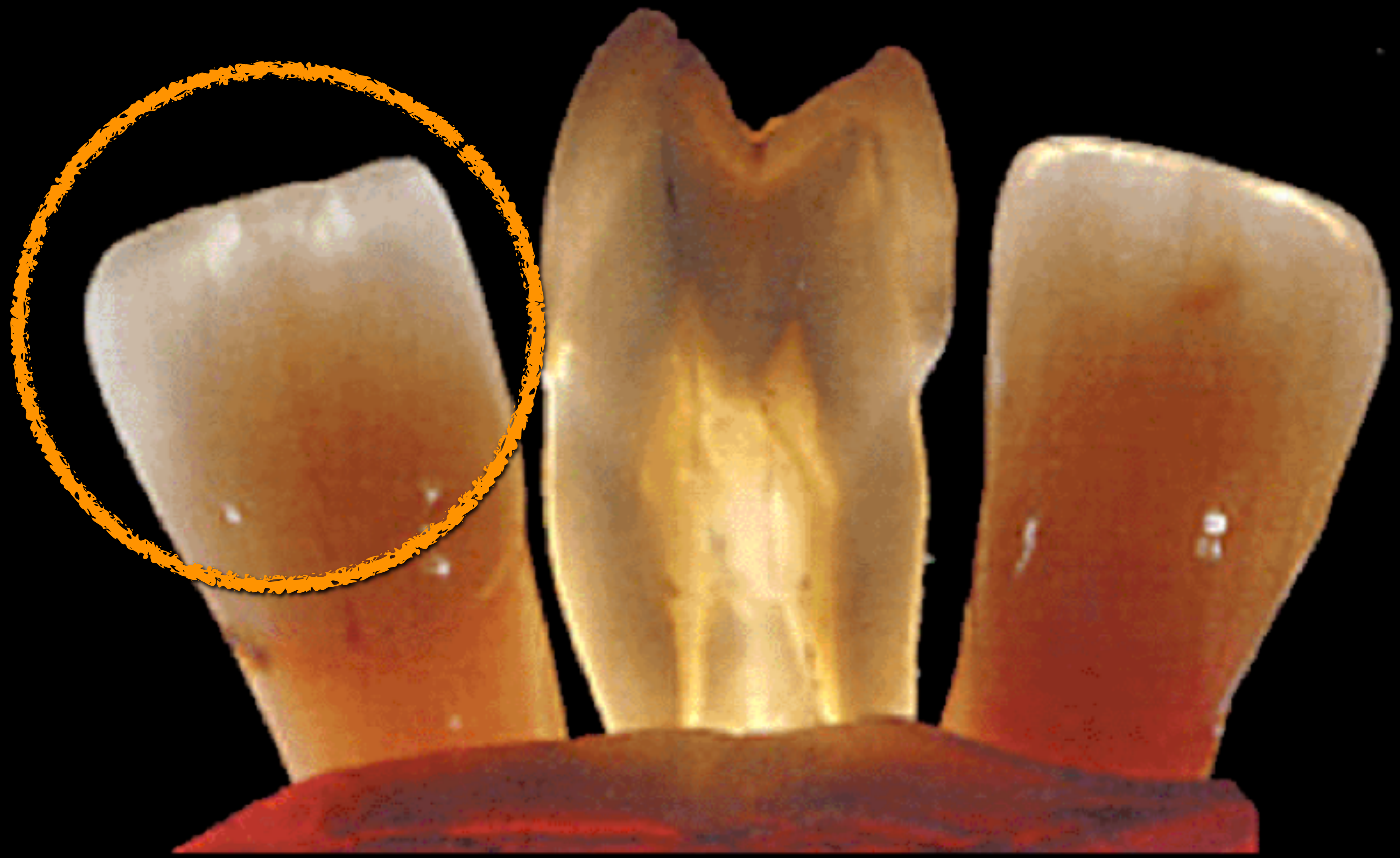
Posterior prototype restorations

Prototype luted and excess cement removed

Test driving the design!

Simulation - 2 dimensional & no harm no foul
Template design - 2 dimensional & no harm no foul
Diagnostic wax up - 3 dimensional & no harm no foul
Mock up - "down and dirty" & no harm no foul
Custom prototypes - following preparations
- accurate preview
- must be accepted!

Materials and adhesion



Categories for materials and adhesion

Adhesive

Resin based restorative

Glass ionomer based restorative

Ceramic based materials

Zirconia based materials

Cements

Why so many material choices?

Increasing demand [illegible]
of bondable toot[illegible]
restorat[illegible]

Driven by patient desires,
technological and biological
advances, plus industry profits!

Questions to ask!

What materials are available?

What are the physical properties?

What are the esthetics?

What are the costs?

What are the long term results?

Are all systems compatible?

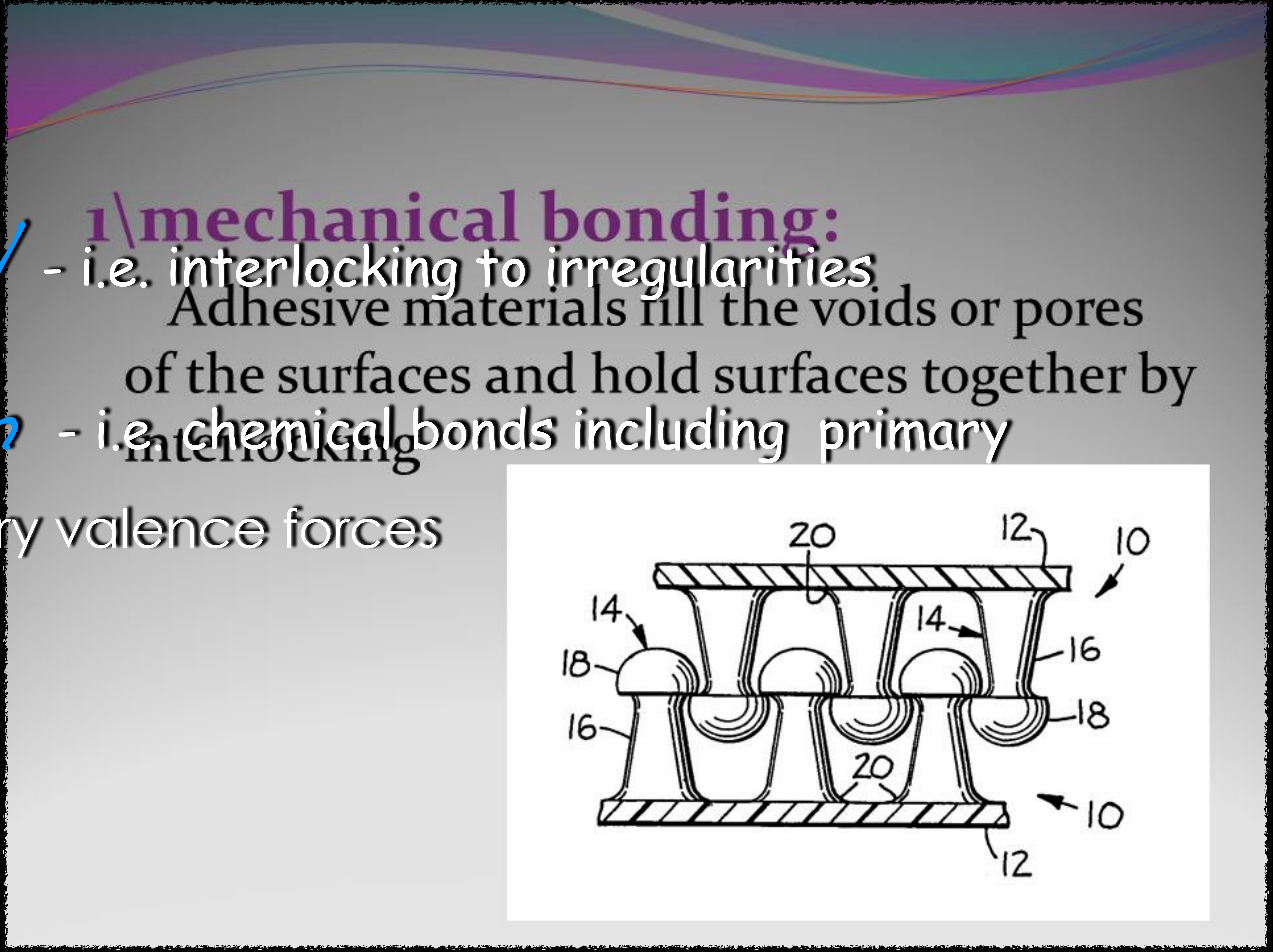
How, when and where do we use them?

Adhesive systems

ad·he·sion
ədˈhēZH(ə)n/
noun:
the action or process of adhering to a surface or object

co·he·sion
kōˈhēZHən/
noun:
the sticking together of particles of the *same* substance

Adhesion



Mechanical - i.e. interlocking to irregularities

Adsorption - i.e. chemical bonds including primary and secondary valence forces

Requirements for achieving predictable adhesive results

Must understand:

Limitations of adhesion

Variability of materials and substrates

What you can and can't control

Selecting the right situation

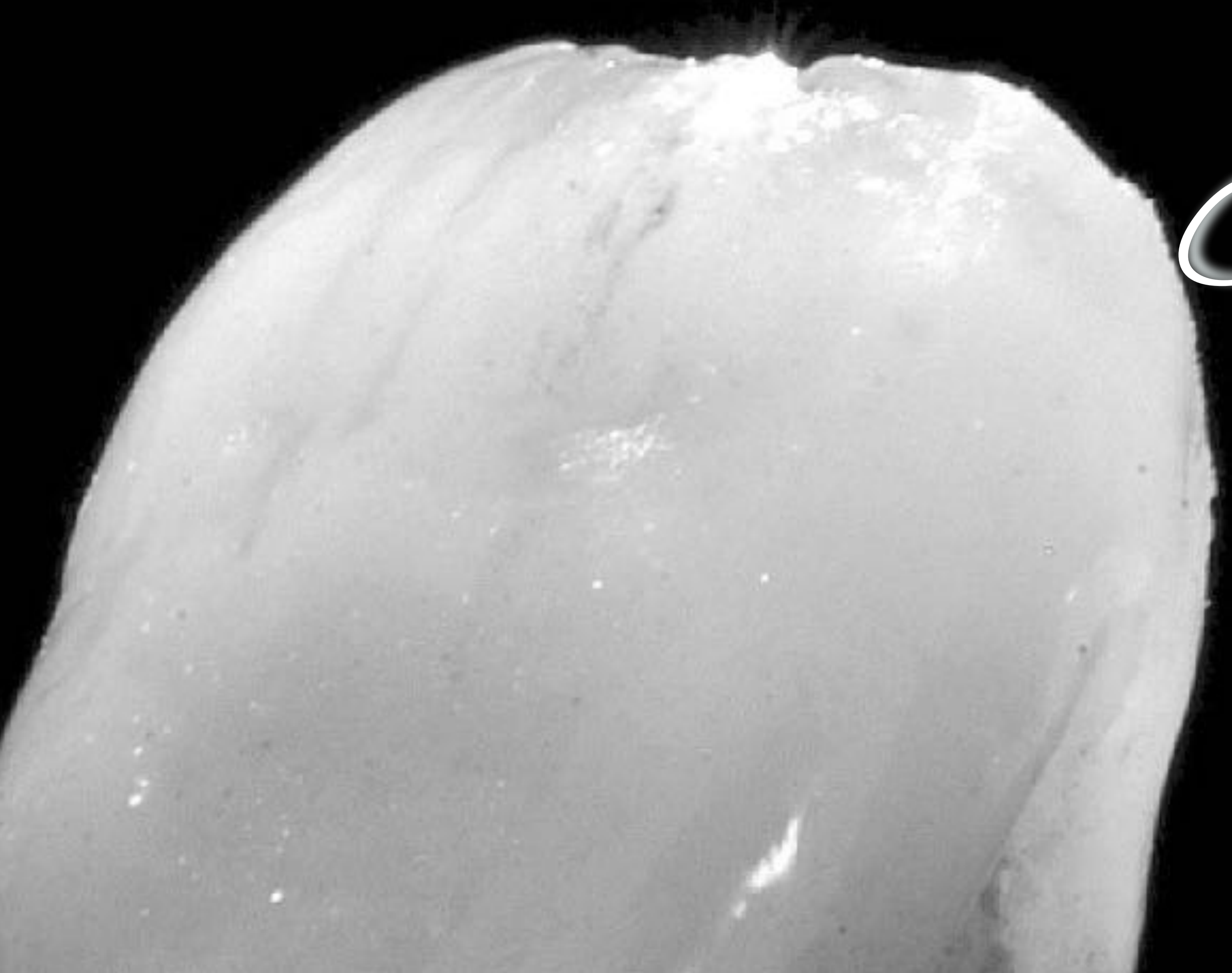
Ideal application

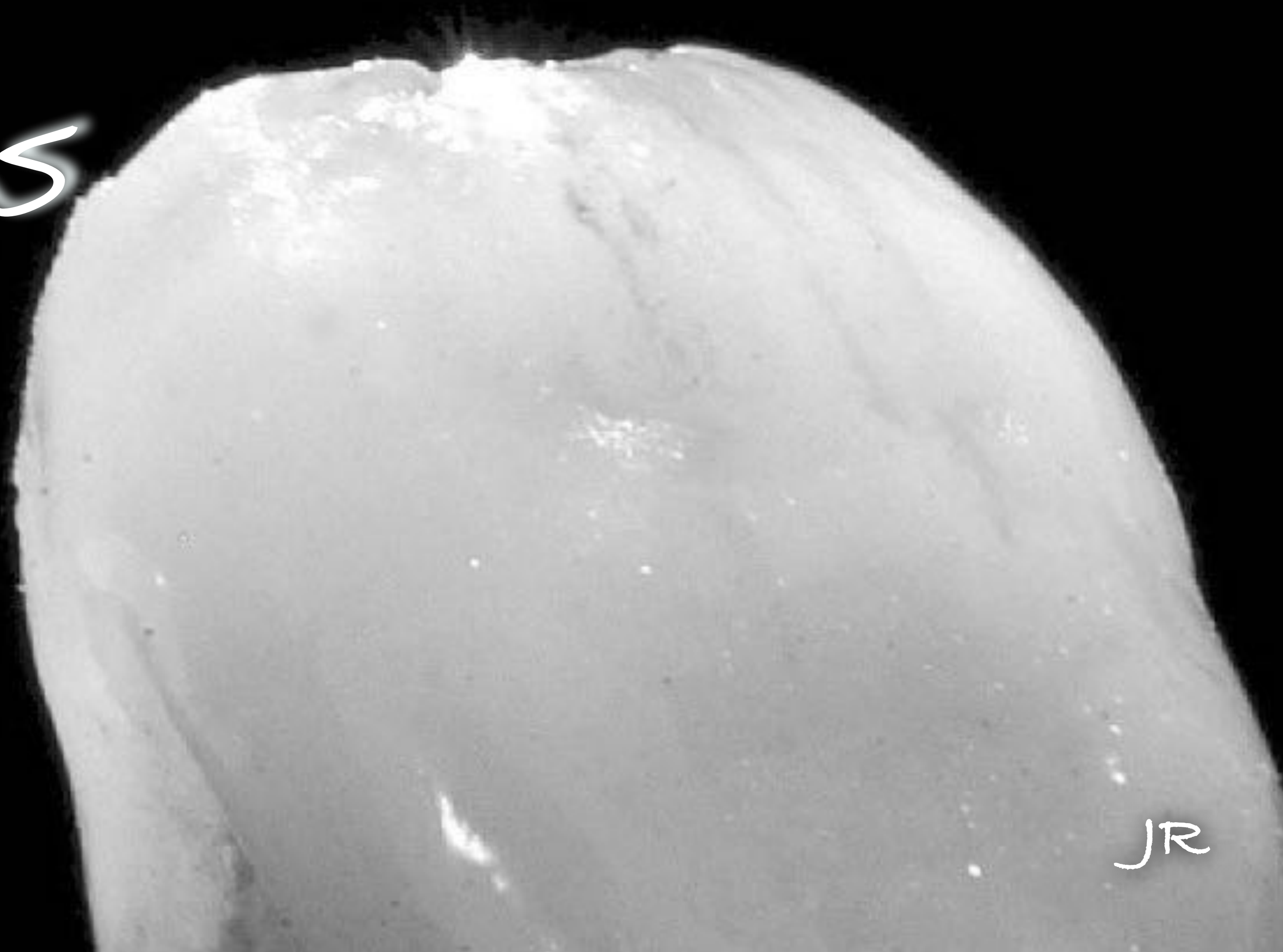
Resin adhesion to tooth structure

The substrates

The products

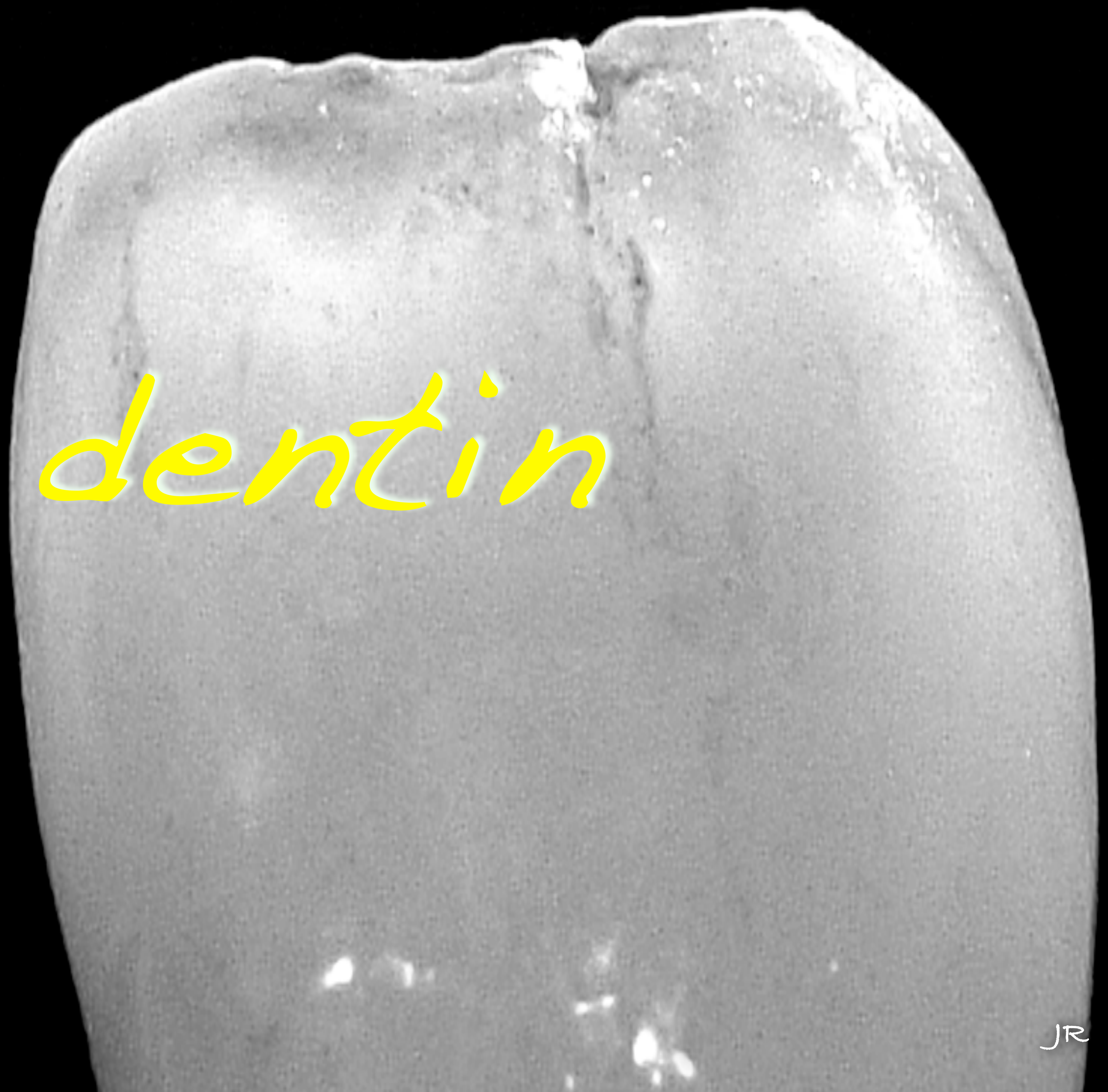
Clinical considerations





JR

Enamel and dentin



Enamel

Low organic content

Collagen = 1% by wt.

Water = 4% by wt.

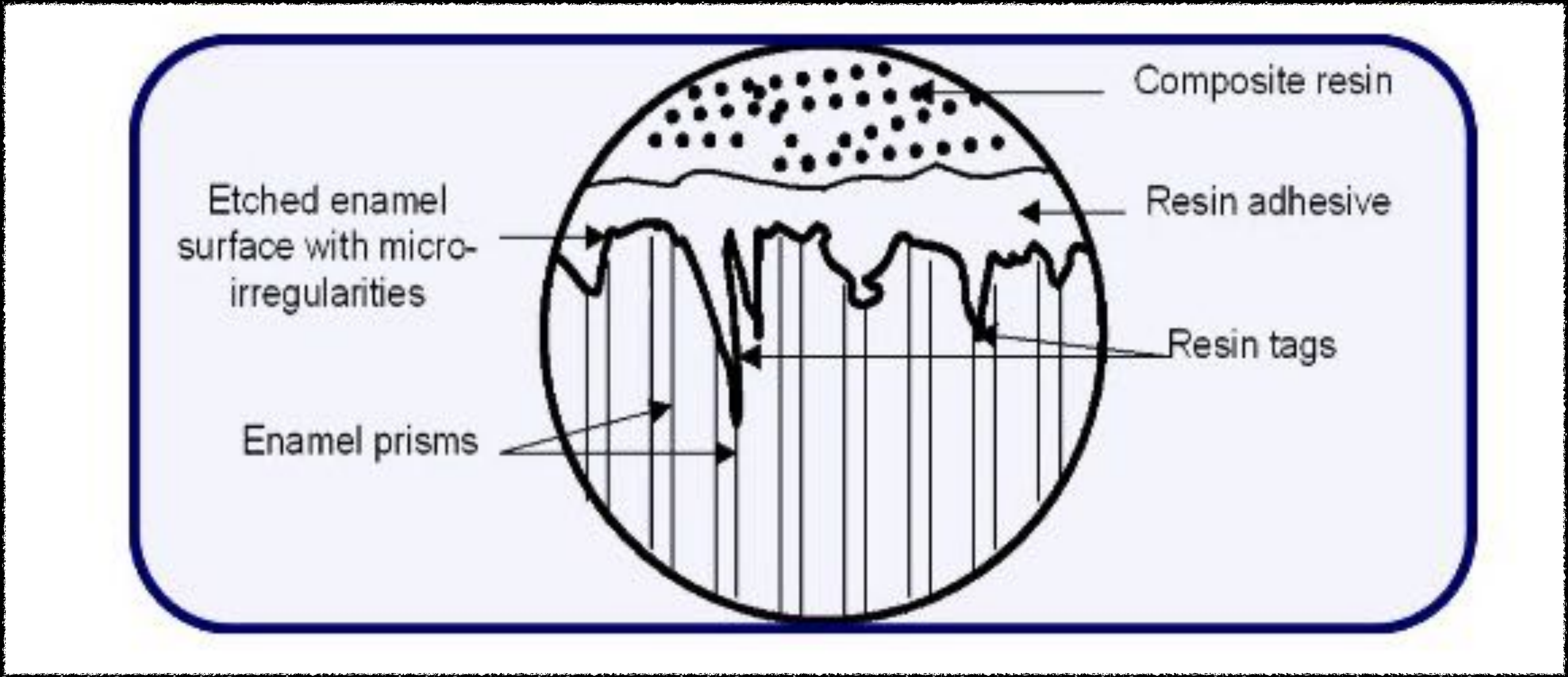
High inorganic content

95% by wt. (calcium hydroxyapatite)

After preparation

Smear layer of ~ 1-2 μm on surface

Enamel bonding



Enamel as a bonding substrate

High mineral content (up to 98% HA)

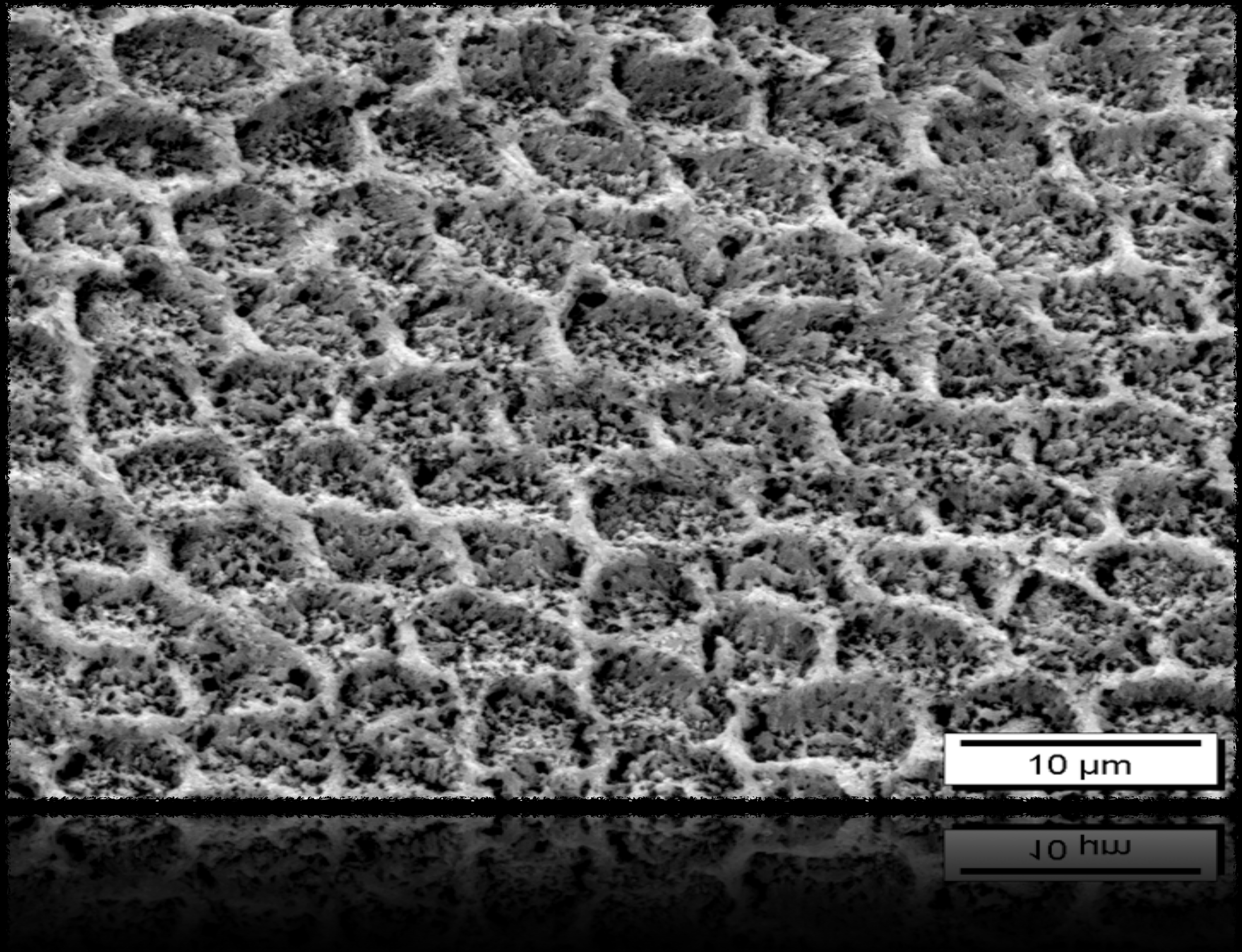
Homogeneous

Consistent predictable bonding

Etch/apply resin → hybridization of surface

Bullet proof and time tested for 40+ years!

Acid treatment



Substantially increases available surface area of the bonding substrate

Increases the surface energy

Enamel surface conditioners

37% phosphoric acid

approx. 30 secs

ideal etch of enamel

Self-etching primers

adequate etch of enamel?

......maybe

Surface energy!

Higher energy surfaces easier to wet

Enamel

Unetched	28 dynes/cm
Etched	72 dynes/cm

Good adhesion requires good surface wetting

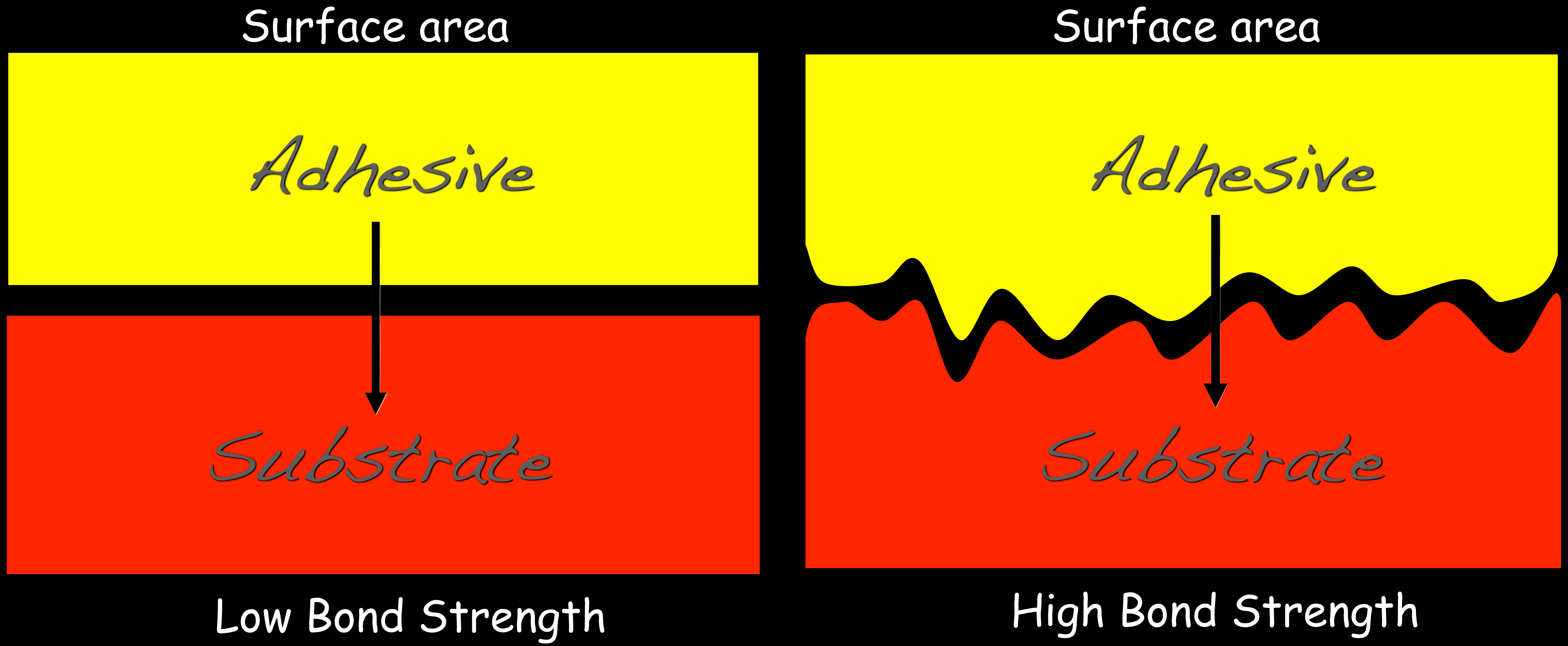
Incomplete wetting

Low bond strength

Complete wetting

High bond strength

Increasing the surface are improves adhesion



Conclusion

Enamel bonding is easy, predictable and bullet proof!

The challenges of adhesion for ALL dentistry!!

Simultaneously treat enamel and dentin

Work in the presence of moisture

Bond well to many different substrates

Enamel, dentin, porcelain, metals, composite

Rapidly develop high bond strength

Gap free restoration interface

Technique insensitive

Biocompatible

......what we want!!

JR

Dentin

Moderately high organic content

Collagen = 20% by wt.

Water = 10% by wt.

Inorganic content

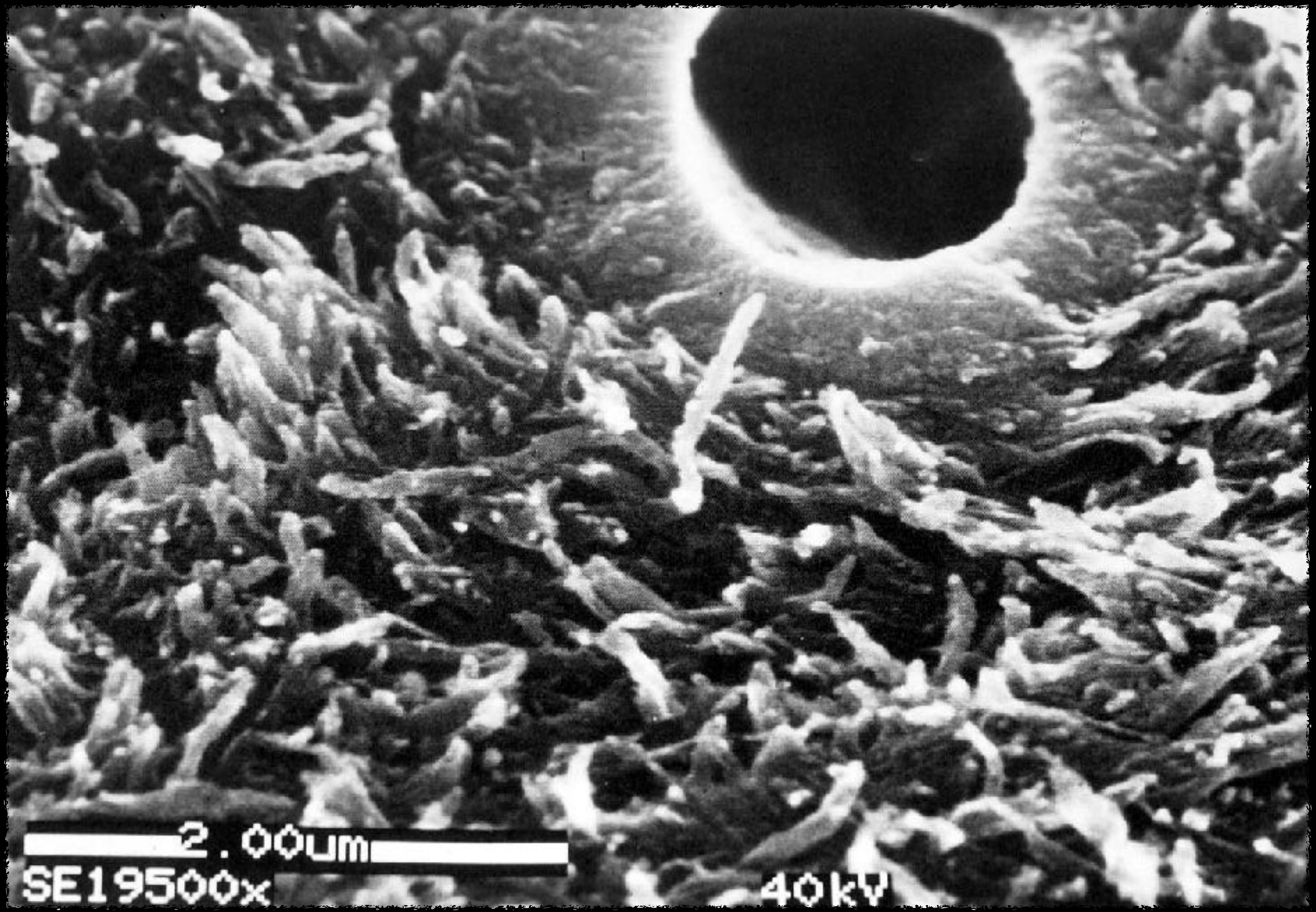
70% by wt. (calcium hydroxyapatite)

Outward intrapulpal pressure of 6.9 kPa

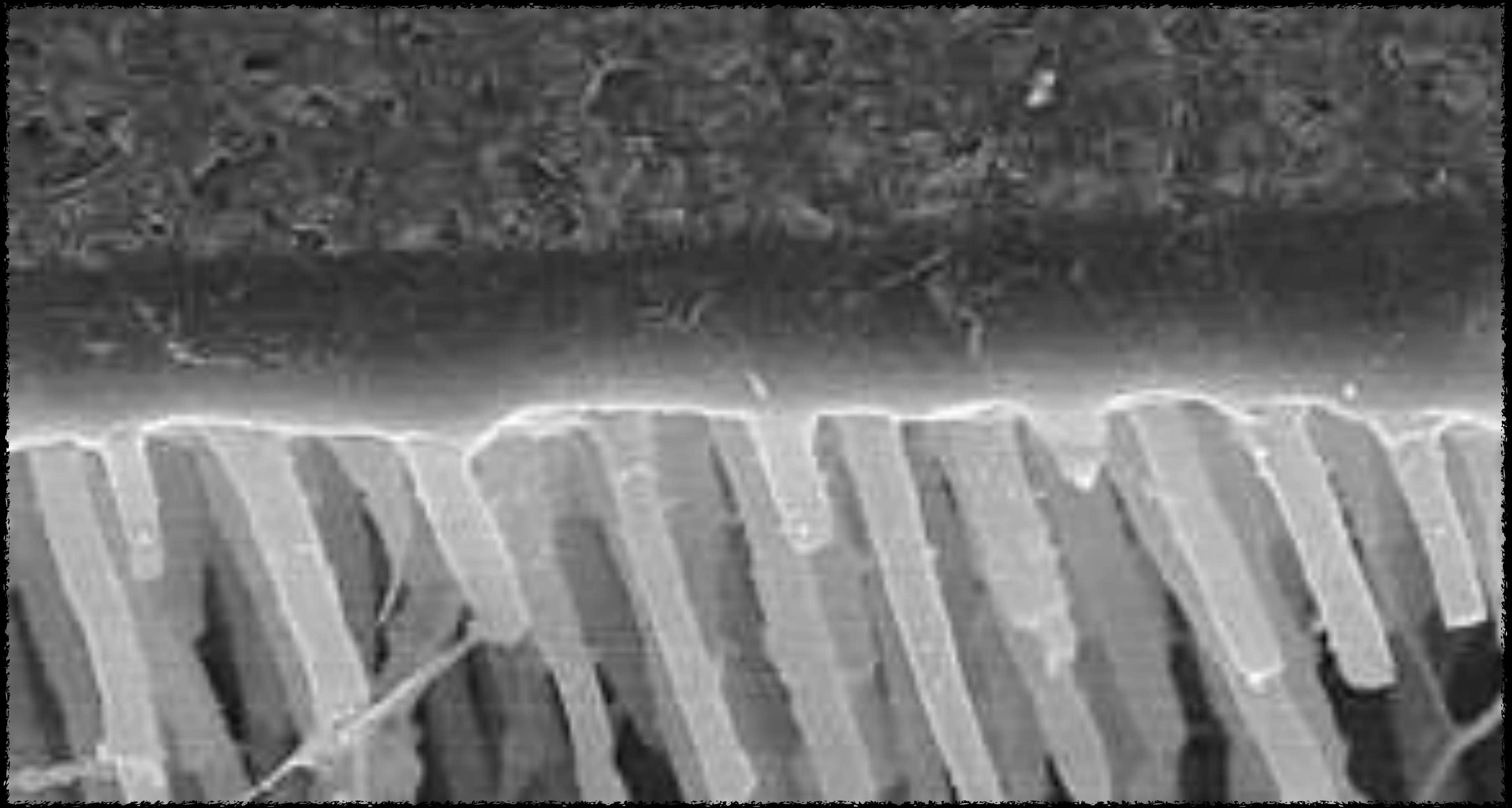
After preparation

Smear layer of ~ 1-2 µm on surface

Smear plugs 2-3 µm inside dentinal tubules



Dentin



So, if etching works for enamel;

maybe we should etc dentin?

The effects acid on dentin

Removes the smear layer

Opens the dentinal tubules

Increases the permeability of dentin 5-20 times

Partially demineralizes dentin surface

(Calcium hydroxyapatite)

Creates a loose organic collagen layer 5-10 microns thick

If you open the tubules you have to seal them !!

Primer

Wets and bonds to exposed collagen

Prepares the collagen to accept hydrophobic bonding resins

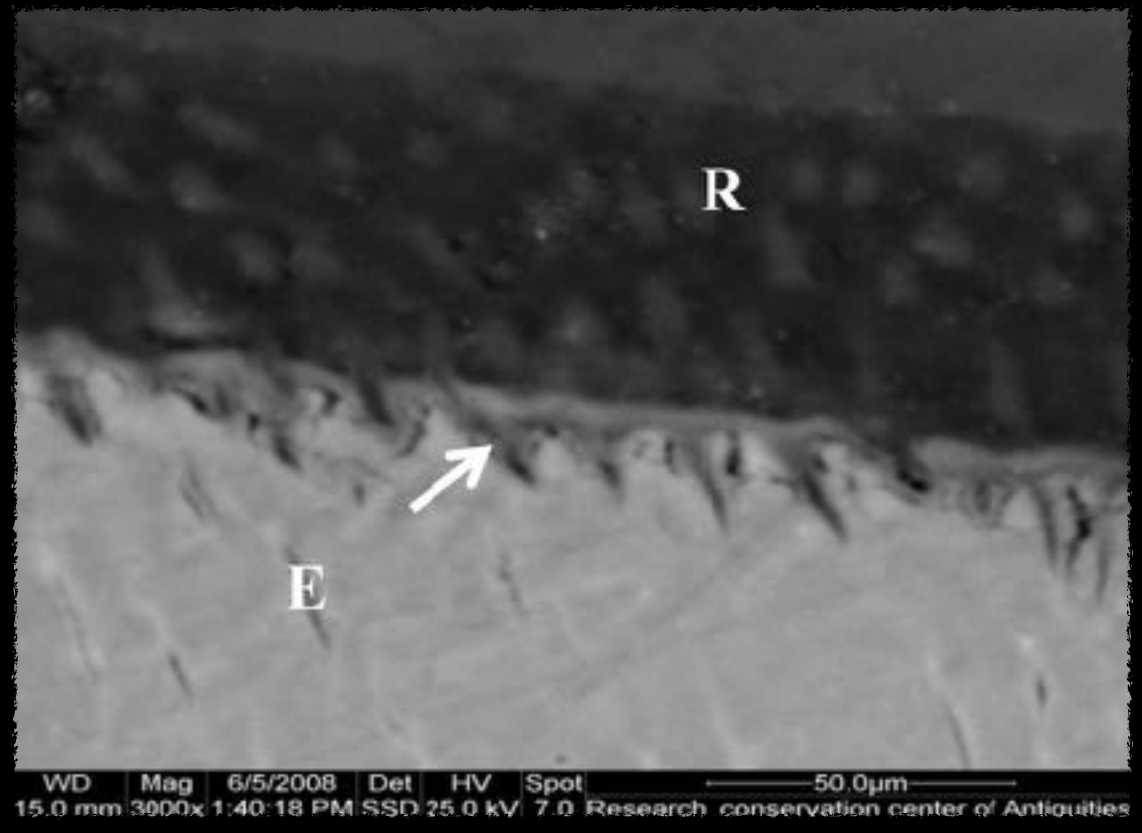
Utilize bi-functional molecule with hydrophilic end and hydrophobic end

Begins hybridization process

Bonding resin

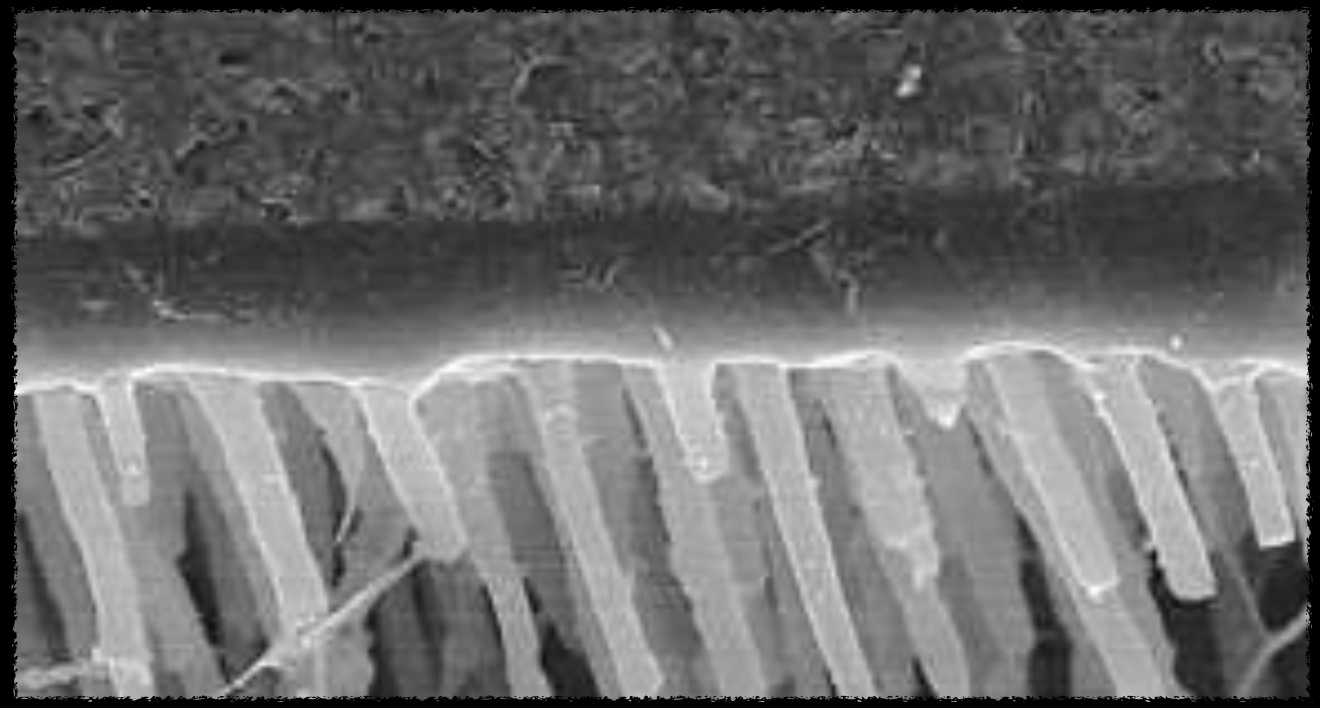
Enamel:

Micro mechanical retention to etched tags →



Dentin:

Seals dentinal tubules →



Mechanical and chemical link to hybrid layer

Provide a chemical link to the composite layer

Based on current knowledge…

pre-requisites for effective dentin bond

Etch

Prime

Bond

Major dentin technique adhesive bonding errors

Dried out dentin after rinsing off the etchant – "over dry"

(Caused frequently by frosty enamel validation of etch)

Not dry enough – "over wet"

Applying insufficient adhesive

Overly aggressive evaporation of the solvent

Partial or total loss of adhesive

Scattering / thinning the adhesive

Inadequate evaporation of the solvent

Light cure and dual cure adhesives

Restorations that do not allow adequate light penetration,
require a dual-cure additive to complete polymerization!
i.e. inlays and onlays

This applies to 4th and 5th generation adhesive systems.
e.g. Solo Plus Dual Cure – SDS Kerr
Prime-N-Bond Nt Dual Cure – L.D. Caulk

NOTE!

Self etching primers are LIGHT CURE ONLY!!
unless a dual cure component is available
e.g. Universal - 3M

Why another new adhesive?

Dentists always looking to reduce the time for adhesive restorative procedures

Post operative sensitivity still a major problem for the dentist

4th and 5th generation adhesives require wet field for highest bond strengths

(especially acetone based)

Proper degree of wetness is;

Hard for manufacturer to explain to dentist

Hard for dentist to visually assess

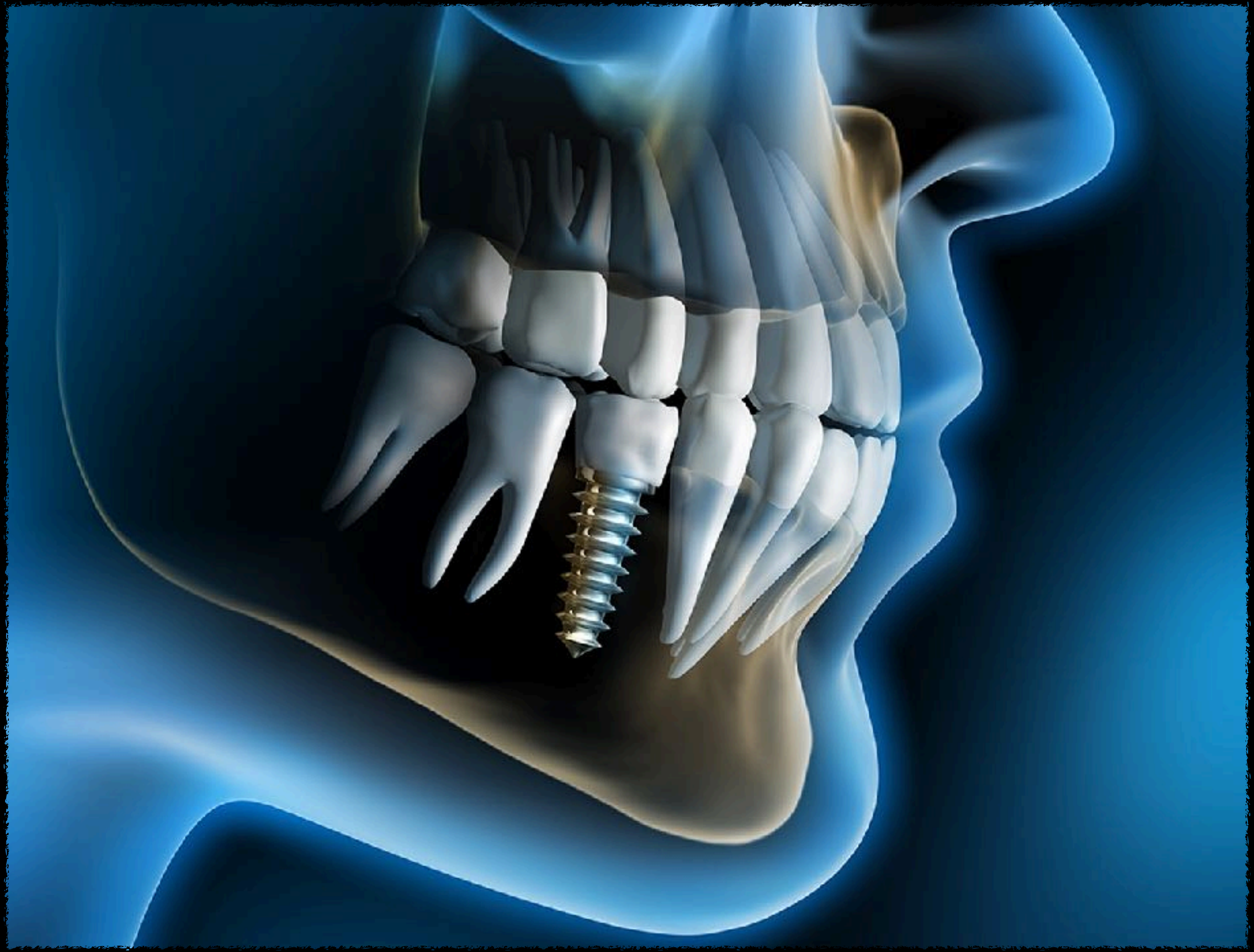
"How wet is wet?" "How dry is dry?"

6th generation adhesives must be mixed properly to work efficiently

Technique sensitive and difficult to visually assess

7th & 8th generation adhesives "all in one" bottle, no mixing; but is the bond good enough?

Wish list for dentin bonding



Dentin bonding versus implants

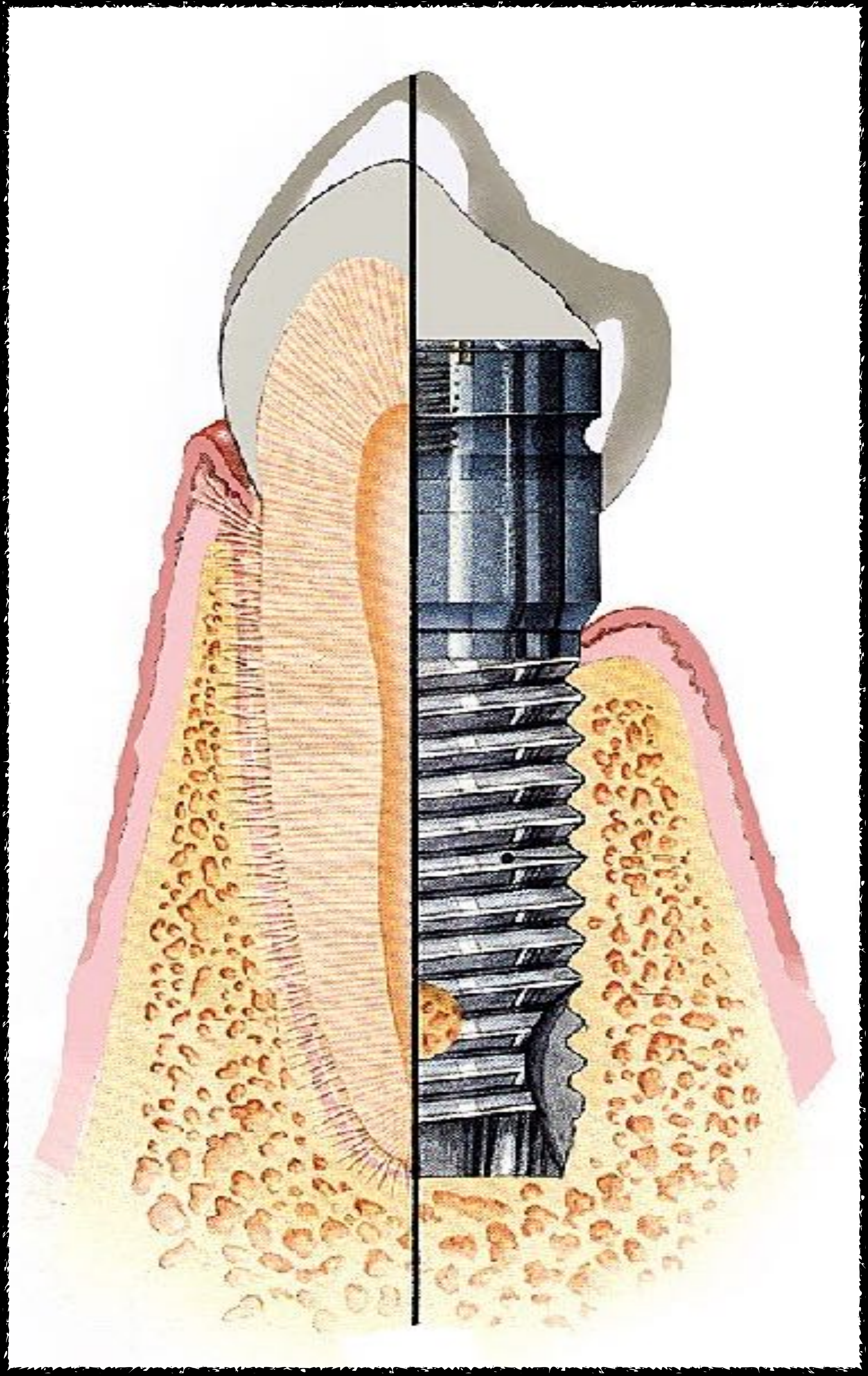
BONE

Highly bioreactive

Implant surface affinity

Molecular attachment
(osseointegration)

Stability of interface



DENTIN

Not bioreactive

No affinity for resins

Mechanical attachment
(adhesion)

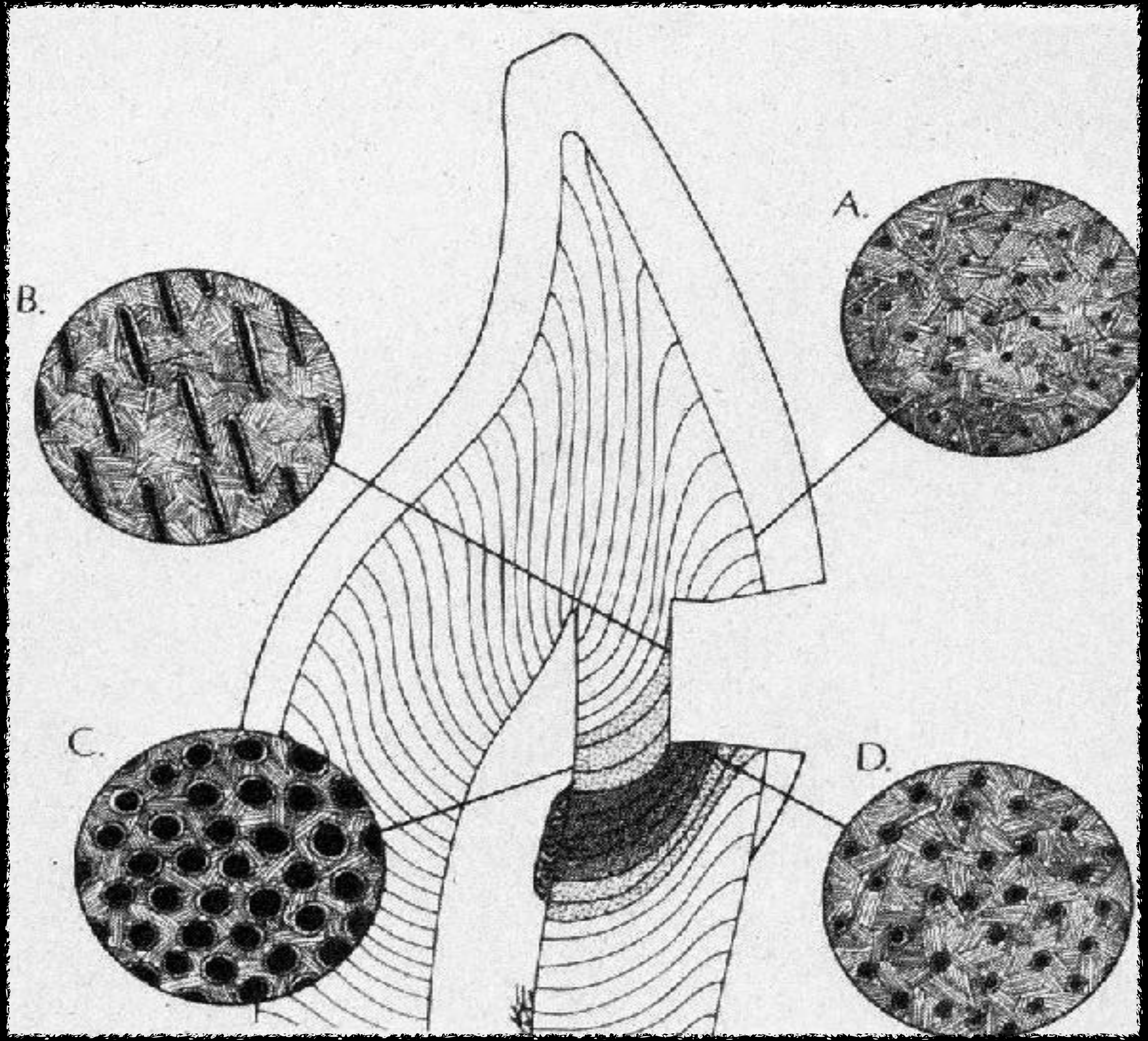
Degradation of interface

What are the challenges and obstacles dentin bonding?

Variable tubule density

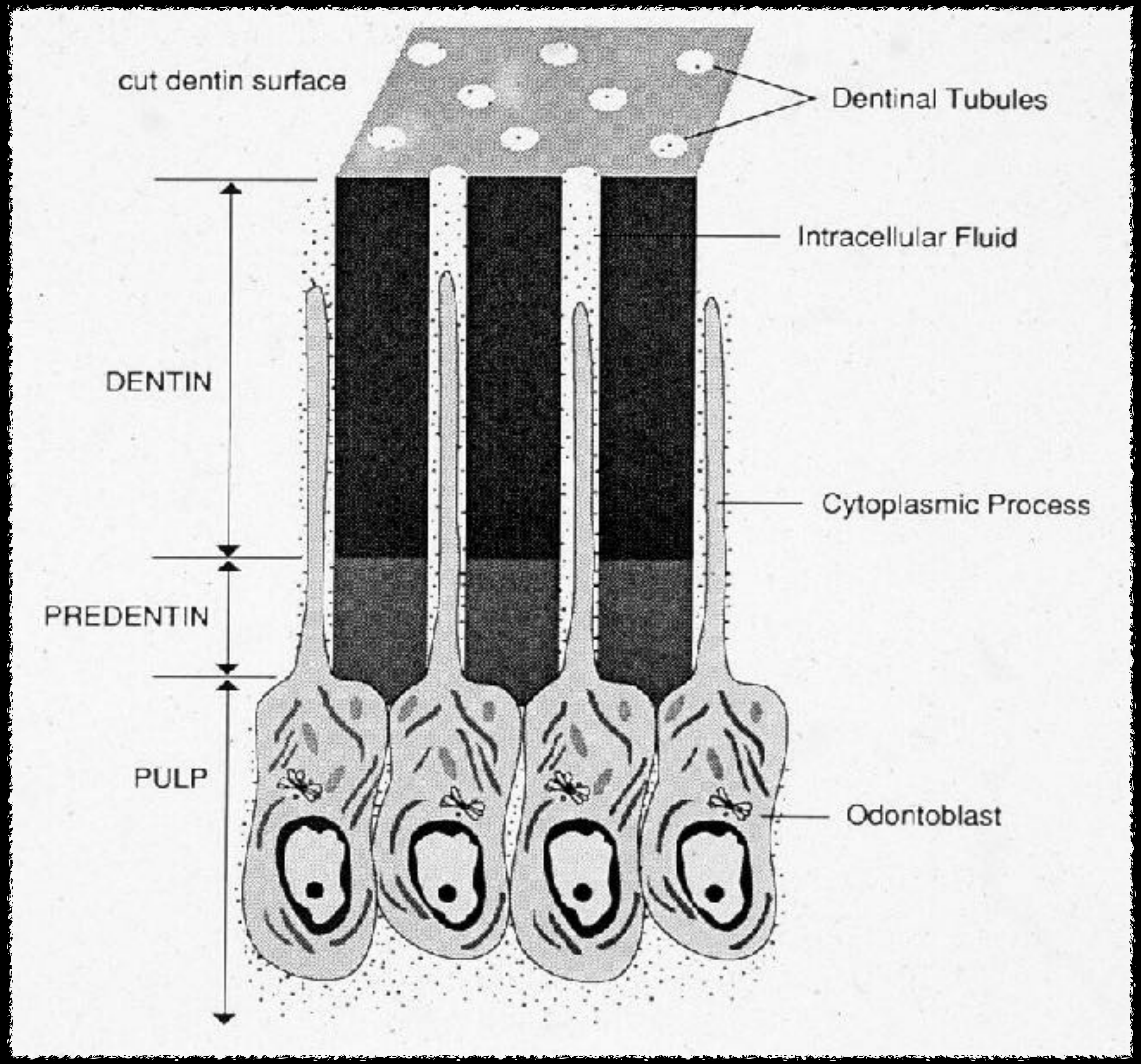
Variable surface morphology

Variable water content

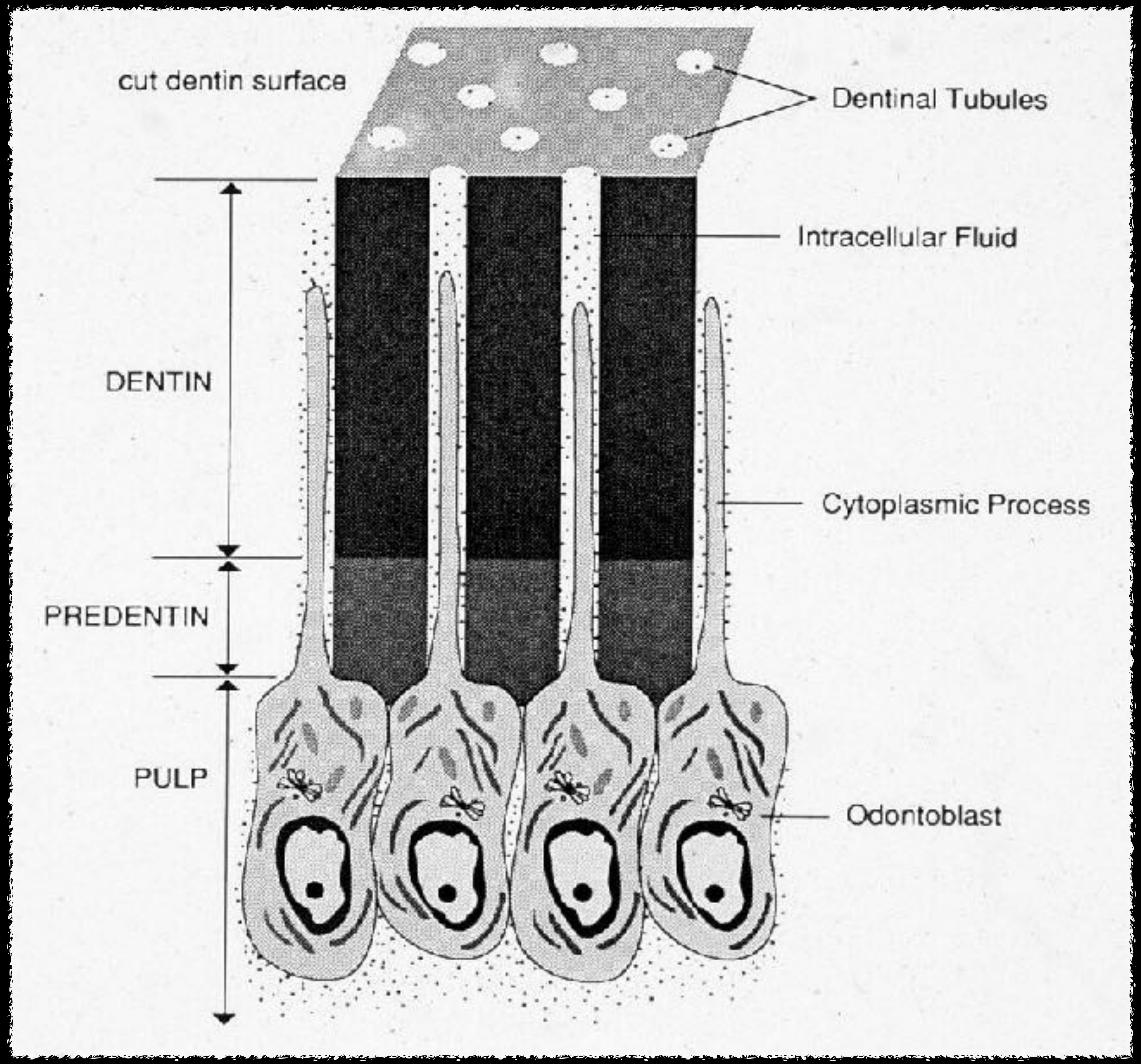


Dentin as a bonding substrate

- Structure is complex and non-homogeneous
- 45% - 65% HA
- Water, collagen, proteins
- Tubules
- Cellular processes



Resin dentin bonding procedures are far LESS PREDICTABLE vs. enamel bonding



Sclerotic dentin → hypermineralized

Acid resistant → low permeability

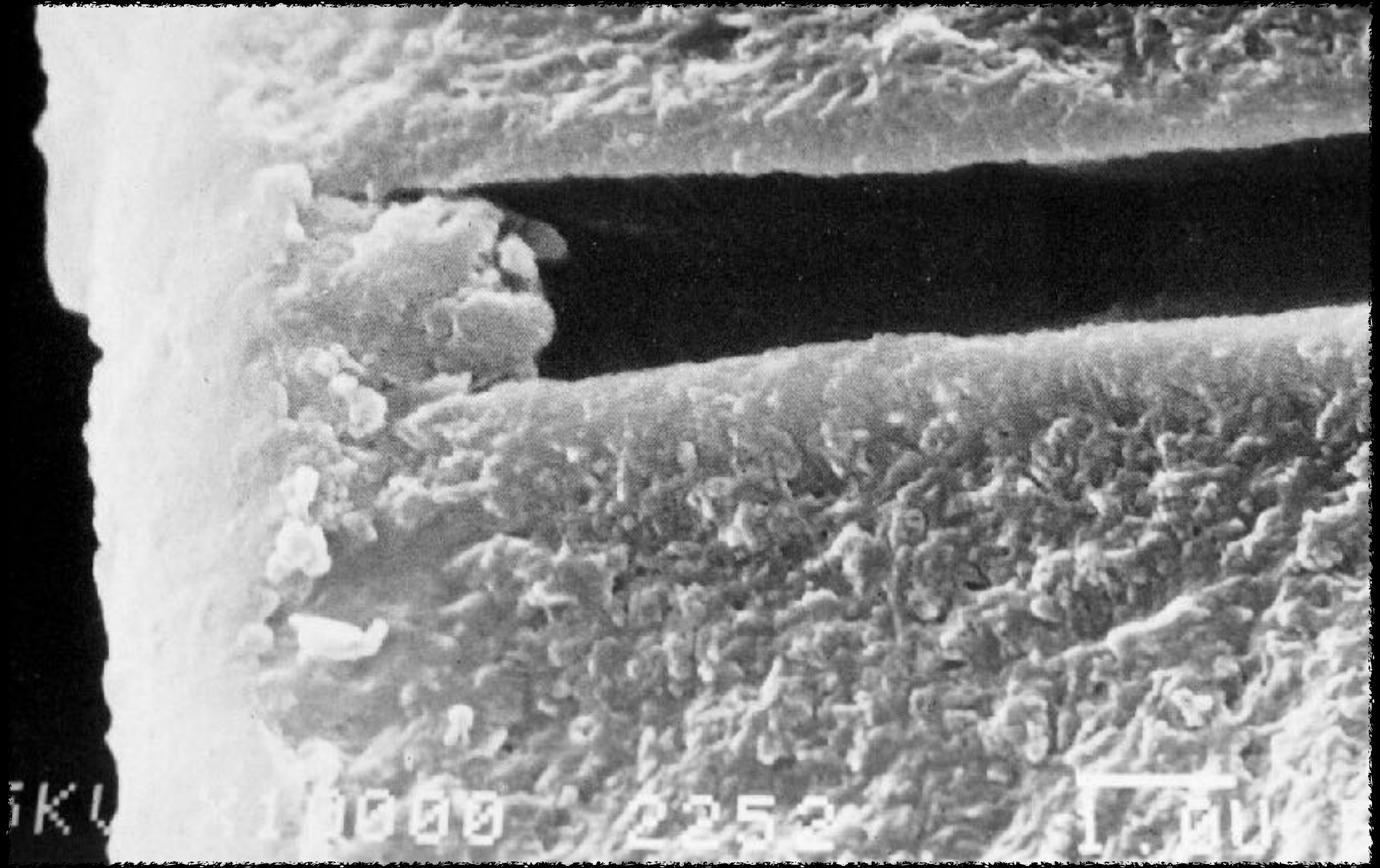
POOR BONDING

Prepare?

Longer etch time?

Smear layer

- Debris layer produced by instrumentation
- Poor bonding substrate
- Must alter/remove to access underlying dentin



What do we conclude?

Enamel substrate stable

Predictable and stable bond

Dentin substrate varies

Unpredictable and variable bond

Dentin resin bonding

Acidic conditioner *(etchant)*

37% phosphoric *(no more than 10-15 seconds)*

Acidic conditioner (etchant)

↑ dentin permeability

Hydrophilic primer

Hybridization

Resin tags

Adhesive resin

Stabilization and copolymerization