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Adhesion Dentistry 2014

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Adhesion to various substrates

- **Enamel**: phosphoric etch, adhesive (ideally Photo Bond or Prelude #2)
- **Dentin**: phosphoric etch or self etch, enamel-dentin adhesive
- **Pressed ceramic**: HF etch, silane, Panavia; or Al_2O_3 sandblast (no HF), Clearfil Activator mixed with Prelude #2 or Clearfil Photo Bond
- **Porcelain**: HF etch, silane, unfilled resin (?), flowable composite (light cure) or Panavia F 2.0 (dual cure); or Al_2O_3 blast, Clearfil Activator mixed with Prelude #2 or Clearfil Photo Bond or CoJet/Rocatec/SilJet plus silane
- **Lab composite**: Al_2O_3 sandblast and Clearfil Activator mixed with Prelude #2 or Clearfil Photo Bond or CoJet/Rocatec/SilJet plus silane
- **Base metal**: Al_2O_3 blast, Panavia F 2.0 or SilJet/CoJet plus silane
- **Gold**: Al_2O_3 blast, tin-plate or noble metal primer, Panavia F 2.0 or CoJet/Rocatec/SilJet plus silane
- **Zirconia, Alumina or Spinell** (non HF etchable ceramics): Al_2O_3 blast, Panavia F2.0; or CoJet/Rocatec/SilJet plus silane; or Al_2O_3 blast and then Z Bond followed by ordinary resin cement such as Starfill 2B

Ray's bonding recommendations for 2014:

Class I, II, and V composites
Prelude SE (#1 and #2) **OR** Clearfil SE Bond. (For large Class V, separately etch enamel only or use Prelude #2 in total etch method)

Class III and IV Composites
Total etch and Prelude #2 only **OR** total etch and Clearfil Photo Bond.

Indirect restorations that require dual-curing (eg. crowns)
Panavia F 2.0 (Normal set: ED Primer; Slow set: total etch, Microprime G, Photo Bond) **OR** Prelude SE with Link, then dual cure composite such as Starfil 2B or Variolink 2 (Panavia F 2.0 is OK but fast set).

Indirect restorations that are light curable (eg. porcelain veneers)
Total etch, Clearfil Photo Bond, and Accolade PV
OR total etch, Prelude #2 only, Accolade PV.

Bases
Fuji Triage (Fuji 7), only if residual caries, otherwise no base.

Bonding to existing porcelain or composite
Al_2O_3 sandblasting followed by Clearfil Photo Bond mixed with Clearfil Porcelain Bond Activator **OR** Prelude #2 mixed with Clearfil Activator

Bonding to existing metal
Al_2O_3 sandblasting followed by Panavia F 2.0 or Photo Bond (on noble metals: tin-plate or apply Tokuyama Metaltite after sandblasting).

Ray's composite recommendations for 2014:

Universal anterior/posterior, sculptable, "nano" spherical composite
Z Nano or Estelite Sigma,, favorite shades: A1, A2, OA2, OPA2, Bleach

Microfilled flowable composite (for class V or facial enamel)
Aria, favorite shades: Incisal, A2

Flowable hybrid radiopaque composite (for first increment and up to enamel): Accolade SRO, favorite shade: A2

Veneer bonding composite
Accolade PV with matching Try-in Composite

Core buildup and base/blockout composite for Cerec
Clearfil Photo Core

Metal (or stain) blockout:
Accolade OP Mask, shade A-2

Re-attachment of tooth fragments

It is wise to do a "try-in" first! Do not use composite! Just use bond on both tooth surfaces. If there is a chip or other defect, fill it in with flowable composite after reattaching the fragment. A microfilled composite (Aria (Danville), Renamel Flow (Cosmedent)) would be best for the fill-in since it maintains an enamel-like gloss and resists wear. It is wise to use a dual-curing bond since light may not penetrate the entire tooth easily, especially in thick areas.

Prelude SE technique: Total etch with phosphoric acid, wash, dry to dampness or remoisten dry surface, Apply *Adhesive* (#2) on both sides, air thin Adhesive, apply *Link* (#3)to only one side, quickly seat and light cure. (Prelude with Link will dual cure so do not worry about thorough light curing.)

Clearfil SE Bond technique: Apply SE Bond *Primer* for 20 sec, air dry, apply SE Bond "*Bond*" to both sides, seat and light cure very well.

"Bite-formed" posterior composites…
by converting a class II into a Class I

A product specific technique: for Clearfil SE Bond or Prelude SE

1. Place rubber dam or otherwise isolate.

2. Cut conservative prep (Fig. 1), using Caries Finder or Caries Detector to guide prep and caries removal. Stop at "pink haze" on the pulpal floor. Small bevels on the occlusal margin are generally desirable to prevent white line formation. If the marginal ridge is not fractured or cracked, cut a "tunnel" prep, leaving the marginal ridge intact.

3. An optional but highly desirable step is to use air abrasion to clean and roughen the prep after caries removal. (Fig. 2)

4. Apply Prelude Primer (#1) (or SE Bond Prime) to dry or damp enamel and dentin for 10 sec. (SE Bond requires 20 sec.) (Fig. 3) These are minimum times, longer is OK; agitation improves it. Take care to be sure that the occlusal margin remains wet with the liquid primer. It is not necessary to light cure the primer (It's too thin to polymerize, due to oxygen inhibition). Note: the matrix may be applied before or after placing the adhesive. Shown here is placement before. With Clearfil SE Bond, the adhesive may bond to the metal matrix, with Prelude SE this is not a problem.

Figure 1

Figure 2

Figure 3

5. Air dry only (no wash).

6. Apply Prelude Adhesive (#2) or SE Bond "Bond" with a clean Microbrush. SE Bond should be wicked off with a dry Microbrush to avoid creating a thick, radiolucent layer. Prelude need not be wicked, just air dried to evaporate solvent. Avoid air thinning SE Bond (contrary to the manufacturer's instructions) since it may over-thin the Bond layer on the margins and leave radiolucent pools in corners.

7. Light cure the Adhesive/Bond layer (light cures the primer too).

8. Place Danville long or short Contact Matrix if not done previously. Wedge if the gingival margin needs to be closed. The Danville "elastowedge" (actually called the Contact Wedge) is nifty when there is a long tooth or a root concavity. (Fig. 4) If a wood wedge is used, it is usually is best to invert the wedge, "apex down", or use a round toothpick instead. When placed apex upward, the wedge tends to distort the contour of the matrix and it might even open the contact.

9. Add Danville Contact Ring or MegaRing. (Fig. 5) The converging tines of the Danville rings allow placement above the wedge with good retention and matrix adaptation.

10. Apply a thin coat of light cure flowable composite (Accolade SRO recommended) with needle tip to cervical margin only. Cure this layer. Then add more flowable composite to build a marginal ridge to full height. Cure increments as necessary, never exceeding 2 mm per increment. (Fig. 6)

Figure 4

Figure 5

Figure 6

11. Place a thin layer of flowable composite to the pulpal floor (if not already slopped on there!). Light cure again. Now add more flowable to the level of the enamel but not onto the enamel. Avoid "coupling" the dentin and enamel. (Clearfil Photo Core, rather than Flowable composite, is a nice material for thicker increments.) Light cure again.

12. Remove rubber dam if used.

13. Remove matrix. A MegaGrip forcep may come in handy here.

14. Mark occlusion (Fig. 7) and adjust the marginal ridge to allow full CO closure. (Fig. 8) You now have a class I cavity to fill!

15. Wash and dry prep. Optionally, place a layer of bonding agent to re-wet prep and composite surface. Place light cure posterior composite (such as Heliomolar for best wear resistance, AP-X for best strength, Estelite Sigma Quick for best esthetics and handling), slightly overfilling, taking care to insure all margins are covered. (Fig. 9) One increment will usually suffice for the "enamel" layer. Saliva will not displace the composite; just be sure that the margins are closed before exposing to saliva.



Figure 7 Figure 8 Figure 9

16. Place a glycerine gel (Danville's translucent blue Liquid Lens is ideal) on the occlusal surface of the composite. (Fig. 10)

17. Have patient bite into CO. While in CO, is sometimes possible to trans-enamel cure from the buccal. (Fig 11) The bite will establish the occlusion, leaving only some flash of composite to remove.

18. Have the patient open and light cure from occlusal. A "soft start" cure (150-200 on meter for at least 10 sec, then stronger light) decreases stress in the composite.

19. Finish and polish. I like a Raptor to add grooves, then Vivadent's Astropol cups and wheels to final polish.

20. Option: Phosphoric acid etch the occlusal, wash, dry, apply Fortify Bisco) and light cure.



Figure 10 Figure 11 Figure 12

Reference:

Bite-formed posterior resin composite restorations, placed with a self-etching primer and a novel matrix, Bertolotti RL and Laamanen H, Quintessence International 1999; 30:419-422.

Hydraulic & Hydrophobic (H & H) Impressions

All VPS materials are inherently hydrophobic. "Hydrophilic VPS" materials are somewhat modified in the direction of being hydrophilic but certainly are not what we would term hydrophilic in the manner of hydrocolloid or alginate. As such, all VPS materials are all capable of displacing blood and saliva in the "H and H" technique.

the H&H (hydraulic and hydrophobic) technique:

This technique was developed by Dr. Jeff Hoos of Connecticut. Regardless of many doubters, I have verified that this technique can be very accurate, perhaps even "too accurate" since it captures the smallest scratches and

undercuts. It is so remarkably comfortable that it works well even for gaggers who claim they can't tolerate a tray. The key to the technique is vastly different "durometer" readings for the two VPS materials used. I use Danville's Stiff Bite and First Quarter Light. Do not use "putty" in place of the Stiff Bite! Putty is too low in durometer reading (distorts too much). While the technique can be trayless, it is more convenient to use a closed-bite tray to deliver the materials to the mouth. (I use the rimless plastic ones, like Dentamerica's.)

Here is how the technique works. The patient bites into the Stiff Bite which forms a "custom tray" around the prep area, muscle molded and assisted by the patients tongue. Lately, as suggested by Dr. Alex Goichman, we have been using spacers cut from produce bags over the Stiff Bite. After the Stiff Bite sets, the patient opens while your fingers retain the impression on the opposing arch. The spacer is removed and the "tray" is spray washed and dried thoroughly while in the mouth, First Quarter Light placed in the tray in the prep areas, the patient closes, thereby exerting hydraulic force on the Light impression material. (If the bag spacer is used, there is no need to wash and dry the Stiff Bite, just remove the spacer.) If it's First Quarter, the patient can open in 1 min, 30 sec. You have the impression. The technique eliminates the need for retraction string. Blood is displaced so there is no need to wash it off!

Upon completion of the impression, it is important that the wash material have thin areas on the occlusal of adjacent teeth, thin enough to show the blue "tray" material underneath. If you cannot see the tray material, it is highly likely that something went wrong.

Now a word of warning: There are a large percentage of dentists who simply can't get the H and H technique to work. There is a far larger percentage who say that it is the best and most accurate technique ever (I am in that group). When I have inspected casts from the non-working cases, I often observe rough or undercut preps. Proper die spacing is another critical issue, you need about 50 microns in the area backed by the Stiff Bite. J Morita's Perfectim removable Die Spacer seems ideal for this application. Use of the bag spacer seems to reduce the need for die space.

Now this may seem obvious but it was apparently not to at least one (duh): never use Stiff Bite in a rigid metal tray; it can lock into undercuts!

Problems sometimes observed are too much wash with no show thru or not enough stiff bite with thin areas on one or both sides of the prep. Other possibilities are use of VPS putty rather than stiff bite or patient movement during the closed bite.

Laboratory procedures for closed-bite impressions

It is important that the opposing models be poured but not be separated from the closed bite impression (Fig. 1) before being mounted in an articulator. The objective is to utilize the bite registration as well as the impressions recorded on both sides of the tray.

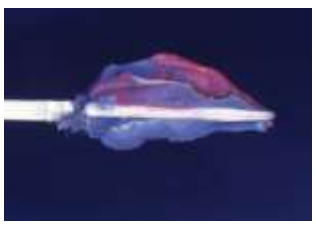


Fig. 1

Fig. 2

Fig. 3

I prefer to pour the prep side first (Fig. 2), dropping a "twin pin" (Zahn Dental, USA) into the stone, in alignment with the prep. I drop in two more twin pins in adjacent areas of the impression, parallel to the first pin, just in case I need to separate those parts of the model. (In the illustration, only one additional pin is shown since the prep tooth is the most distal tooth.) After the first pour sets, I pour the opposing side and mount the poured impression in the articulator with the same mix of stone (Fig. 3). Finally, after the second mix sets, I close the articulator over the pins (that surface lubed with hand soap) and set them with stone (Fig. 4). Note that the die has not yet been removed from the impression - that is the key to accuracy in bite registration (Fig. 5). I use a saw to cut the cast and lift out the pin die (Fig. 6).

Fig. 4

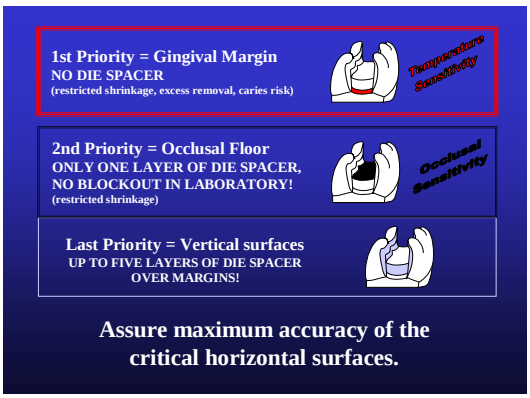
Fig. 5

Fig. 6

If the lab separately pours and then attempts to re-use the impression as a "bite registration" to articulate the casts, articulation errors frequently occur. The usual result is "high" occlusion since the casts have not been fully reseated. Additionally, separate pouring of each side followed by removal of the casts is prone to an articulation error that results from stone getting through occlusal "perforations" in the closed bite impression, creating "blebs". These extra blebs of stone preclude proper articulation of the casts. On the other hand, if the first cast is not removed from the impression before the opposing side is poured, the blebs are compensated in the opposing cast as a negative impression of the bleb, resulting in no vertical dimension error. (If your lab work arrives with remnants of sticky wax or if the impression is cut into a "bite registration", the chances are very good that your lab does not understand the concept of closed bite articulation.)

An advantage of the chrome-spring articulator (Zahn Dental, USA) is that occlusal excursions can be followed by moving the casts through wear facets, working against the spring. The articulator is more rigid than the commonly used plastic, disposable articulators, thereby better for maintaining the cast articulation.

Proper use of die spacing prevents sensitivity

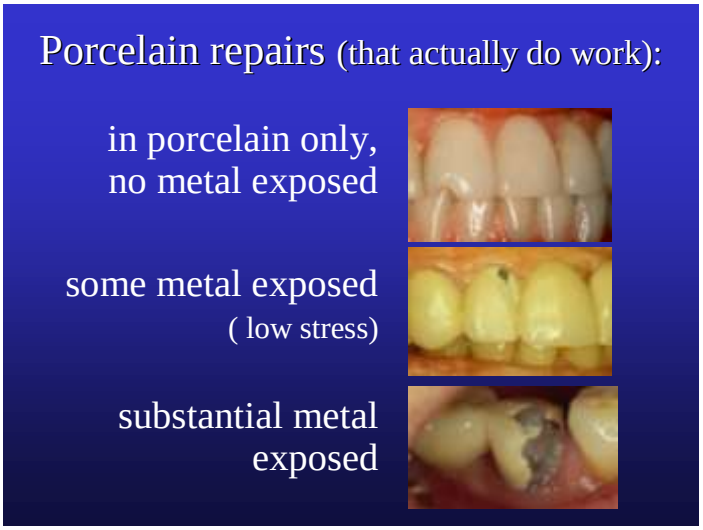


Desensitizing cervical areas

While the best solution is HealOzone for 10-20 seconds, self-etching primers (ideally two step, not the all-in-ones) may be used for desensitizing cervical areas. They do not require anesthesia for application so the result can be immediately tested. The procedure for SE Bond or Prelude SE is to wipe area clean with gauze (avoid procedures that hurt), apply the self-etching primer and bond in the usual manner. The bond layers will stop sensitivity in nearly every case. Then if desired to fill in the contour, apply some flowable composite. A microfilled flowable such as Aria is the most ideal choice. The composite functions only to re-contour. When applying the composite, apply to the gingival area first and cure it, then the incisal portion and cure it separately. This is known as decoupling, minimizing the stresses on the dentin bond.

Porcelain Repairs

There are three variations, depending on how much porcelain is missing, if metal is exposed and if the repair area is under high stress.



Fracture in porcelain only, no metal exposed
(Repair with new porcelain, then bond porcelain to porcelain; new veneer, sectional veneer, or reattachment of fractured porcelain)

Generally the repair will fail if the source of fracture is a flexible metal substructure. (In that case, use the cast metal/porcelain technique below.) If a traumatic fracture, this procedure is usually successful.

1. Etch new veneer surface with HF in lab (or sandblast at chairside, avoiding damage to margins by pinching margins with fingers).

2. Prepare intraoral surface by sandblasting (Danville ERC Microetcher with 25 or 50 micron aluminum oxide) until it looks "frosted".

3. Liquid phosphoric acid wash of both porcelain surfaces for 5 sec.

4. Wash and dry.

5. Clearfil Porcelain Bond (Photo Bond plus Activator) to both surfaces.

6. Bond with Starflow, Accolade or another (translucent) flowable composite if light curable or dual curing Panavia F 2.0 (TC shade) if not light curable.

Porcelain fracture with some metal exposed, low stress.
(or fractured in porcelain only, repaired with composite; also **endo opening** in crown)

These are successful only for low stress situations such as near margins. (For high stress, remove porcelain from the failed unit and proceed as for substantial metal exposure, detailed below.)

(A product specific technique for "Clearfil Porcelain Bond" which is Photo Bond mixed with Clearfil Activator)

1. Create finish bevels in porcelain with a diamond.

2. Sandblast both metal and beveled porcelain with 25 or 50 micron $A1_20_3$.

3. If noble metal (other than non-precious), tin plate the sandblasted metal. Alternatively use Metaltite or Alloy Primer.

4. Apply ordinary phosphoric acid etching agent to the beveled porcelain (The porcelain doesn't "etch" - but surface chemistry is altered by addition of a hydrogen atom to the silica network). Wash and dry. (If some acid gets on the tin-plated metal, no problem.)

5. Apply Clearfil Porcelain Bond (Photo Bond plus Activator), mixed according to the manufacturers directions, to both the metal and porcelain. Gently air dry for 2-3 seconds.

6. Place BelleGlass HP Opaker (Vita shade) over metal areas present and light cure well. This product is critical for good esthetics. Be sure no metal shows thru the opaquer. A few thin coats, each light cured, is best for good cure and opaque coverage.

7. Place composite resin and finish in the usual manner.

Porcelain fracture with substantial metal exposure:

These require overlay castings with new porcelain applied, adhesion metal to metal. May be used for single unit, multi unit, even fractured PFM bridges, with a two unit casting spanning the fractured section.

1. Remove any remaining porcelain and prepare failed unit for an indirect (lab) repair with a path of draw.

2. Make an impression and pour casts.

3. Cast a repair coping to overlay the failed unit. Apply porcelain or other esthetic veneering material. (Rexillium III or IV allows the thinnest and strongest castings.)

4a. If using base ("non-precious") metal repair casting:

Sandblast the inside of the repair casting with 25 or 50 micron $A1_20_3$.

or 4b. If using noble metal repair casting:

Preferably sandblast and then tin plate the interior of the repair casting after all adjustments and try-ins are completed. If tin plated in advance, protect tin-plated surface with Photo Bond prior to try-in. Blow the Photo Bond thin by directing a stream of dry air over the Photo Bond to prevent significant film thickness.

5. Bond repair casting with Panavia F 2.0 to a suitably prepared intraoral surface ($A1_20_3$ sandblasted if base metal or preferably sandblasted and tin-plated if noble metal. Alternatively, use Metaltite or Alloy Primer after sandblast). Use etching and then Photo Bond if any tooth structure is involved in the bonding location since Panavia alone does not bond well to dentin. Use Clearfil Porcelain Bond Activator plus Photo Bond if porcelain is involved. The Activator will not harm the tooth bond.

The non-crown

When we consider that tooth reduction correlates with need for subsequent endodontic treatment, the preferred treatment option often is one which relies on minimal tooth reduction. Adhesion, with less need for tooth reduction, is a highly desirable shift away from tooth preparation for mechanical retention. Metal, lab composite (especially Estenia), or pressed ceramics such as Empress or E Max may be utilized.

Temps on non-retentive preps

For non-retentive preps, "spot bonding" is used to retain the temps yet make them easily removable at the final bonding appointment. This is the method suggested by Dr. Tom Hughes.

1. Make a preliminary impression with a fast set VPS such as Danville's Monophase, in a closed bite “triple” tray.

2. After prep is completed, using a Microbrush, cover prep with Nogenol or TurboTemp 2 Cement mixed with 20% vaseline (this makes a low viscosity, easy to air thin, and slower set material). Thin the mixture with air. (Fig. 2) The "temporary cement" is actually a separating medium (it is not an adhesive cement!) so the temp can be easily removed at the seat appointment.

3. Set the cement with a fine mist of air/water spray from a distance.

4. Air abrade a small "bond spot" in the center of the occlusal, this should be 20% or less of the surface or just be more precise in brushing to leave a hole. (Fig. 2).

Fig. 1

Fig. 2

5. Form Turbo Temp 2 or similar products with the pre-op closed bite impression and let it set completely. There is no need for a bonding agent if the bond spot is on composite. TurboTemp 2 will bond well to the composite. If on tooth, place a spot of Photo Bond on the bond spot (no phosphoric etching used). The Turbo Temp will bond to the Photo Bond.

6. DO NOT REMOVE THE FORMED AND SET TURBOTEMP 2 from the prep. (This way the interprox and occlusal contacts are exactly the way they were before the prep.)

7. Should the temp come off when the pre-op impression is removed, place StarFlow or Accolade in the temp, reseat and light cure.

8. Clean up flash with Retract instrument and/or Bard Parker blade.

9. At final appointment, pry off the temporary and if there is Turbotemp stuck to the composite buildup or tooth, cut it off. If you used Photo Bond without etch, it will most likely come off the tooth clean.

10. In any event, clean up the cement debris with a Microetcher before final bonding.

Variation suggested by Dr. Russ Beggs: Place a spot of Photo Bond on the center of the occlusal, light cure it. Utilizing the preliminary impression, form the TurboTemp 2 directly against the Photo Bond. After removing the impression, light cure Photo Bond through the TurboTemp 2. Clean up flash with Retract instrument and/or Bard Parker blade but do not remove the temp. This Beggs method is not good if there is significant composite on the tooth since too much Turbo Temp 2 will be bonded.

Use of special primers for bonding:

	HF-etchable ceramic	non HF-etchable ceramic	base metal	noble metal
Clearfil Photo Bond		yes	yes	
Clearfil Photo Bond plus **Activator**	yes	yes	yes	
Clearfil **Ceramic Primer**	yes	yes	yes	
Kuraray **Alloy Primer**,		yes	yes	yes
Tokuyama **Metaltite**				yes

Bonding indirect restorations
(E Max, Empress, Wolceram, Procera, Lava, etc.)

1. Adhesive built-in cements

Bonding of tooth colored materials with adhesive cements like Panavia F 2.0 and Bistite 2 DC uses very similar techniques. The adhesives built-in adhesion monomers provide direct adhesion to metal and non HF-etchable oxide ceramics. HF etchable ceramics generally require addition of a silane after etching. Examples are: Empress, Wolceram, E Max and porcelain which are internally etched with HF in the lab and silaned at chairside. Targis, Sinfony, Estenia and most other lab composites, being highly filled composites, are sandblasted (or HF etched) and silaned. Clean Procera, Inceram Alumina, Inceram Zirconia, InCeram Spinell and 3M Lava are bonded by Panavia without any primer or silane. Just sandblast and then apply Panavia or Bistite. Silane is to be avoided here! It gets in the way of direct adhesion.

2. Non-adhesive "composite cements"

Some low film thickness composites can provide excellent adhesion if a suitable primer is used on the restoration. One way is to use Clearfil Ceramic Primer on sandblasted ceramic. Another way is to use Z-Prime (Bisco) or Z-Bond (Danville) on sandblasted zirconia or alumina. Then a "non-adhesive" dual-cure composite may be used in place of the adhesive Panavia. Two favorite brands are Variolink 2 (Vivadent) and Starfill 2B (Danville). Recent research showed that a core composite, Rock Core by Danville, actually had a lower film thickness than both Variolink 2 and Starfille 2B so it should work fine too.

Note about silanes:

Silanes differ in the method of application. I prefer Danville's S-Bond or 3M's Rely X silane (formerly ScotchPrime) since they only need be applied (without acid washing first) and dried. I prefer to protect the internally treated, silanated surface at try-in with a film of Photo Bond, blown thin but not cured. The dual-cure of Photo Bond eliminates worries about light curing completely. Photo Bond is thin enough to be insignificant in affecting fit. Alternatively, you may also use Photo Bond mixed with Activator (a specialized silane). After try-in, the surface can be water rinsed and dried.

Bonding crowns and inlay/onlay with Panavia F 2.0 (TC shade)

1. Anesthetize patient if very cold sensitive (self-etching ED Primer does not usually require anesthesia).

2. If desired to loosen contacts, apply a MegaRing and remove after a few minutes.

3. Remove temporary restoration and pumice or gently sandblast tooth.

4. Unless "high and dry", place rubber dam or retraction cord (Ultradent's #0 Cord and their packers are preferred), preferably saturated with Visine. Specifically avoid ferrous sulfate to avoid bond problems and iron sulfide black stain, “black skuz”.

5. Try restoration onto tooth very carefully. Do not check occlusion on Empress before cementation. Empress is weak at this time. To locate problem areas, G.C. Fit Checker, a white silicone works well. (It is best that Fit

Checker not be placed on the etched surface without a protective resin layer present. Easiest is to place a layer of Clearfil Porcelain Bond (Photo Bond plus Activator) and air thin.

6. Properly clean and condition the internal surface of the restoration. If protection is not done, gentle sandblasting works well to remove contamination but will destroy HF etching (no problem for alumina and zirconia since no HF is used). If HF etching is destroyed, just use Clearfil Porcelain Bond (Photo Bond plus Activator)on the sandblasted surface.

7. Pumice tooth or use sandblasting to remove all traces of try-in resin.

8. Optionally, place MicroPrime G or MicroPrime B (keeping G off soft tissue, be very careful here), let dwell 10 seconds, dry. Apply ED Primer, 30 sec minimum, then dry thoroughly.

9. Place Panavia F 2.0 on the restoration, taking care to have plenty and being sure all internal surface is covered with no voids.

10. Seat restoration gently, watching for a bead of excess Panavia at the margins to assure void removal.

11. It is best to "gel" the Panavia bead with a brief light cure, perhaps 2-3 seconds. Then the gel can be removed with a curette or floss but moisture or blood will not displace the Panavia at the margin areas. If not light gelled, wipe off the excess Panavia with a brush. After about 1.5 minutes, floss contacts or pull a Tofflemire band through and leave it there while curing. Apply Oxyguard 2 or preferably light cure the margin areas. Shade OP (opaque) Panavia will not cure with a light, you must use Oxyguard at the margins.)

12. After 3 minutes, wash off Oxyguard 2, if used (required for OP shade).

13. Finish restoration to tooth using: Horico 4mm Ribbon Saws or Axis Separator to break contact, if necessary. Flexis disks on all accessible margins. Any of the following on margins with limited access: D Fine Double diamaond, Shofu points, micro-fine diamonds, GC strips, usually 600 grit. Polish.

14. Mark occlusal contacts. Ideally, the final check is done with TapeTrix Teflon. Adjust if necessary and re-polish. Brasseler's Dialite/Truluster polishing system works well for most materials.

Bonding crowns and inlay/onlay with StarFill 2B

While StarFill 2B was designed for other applications, it has become apparent that it works well for adhesive cementation procedures. Its film thickness (ISO 4049 test) of 22 microns is in the range of other products intended for adhesive cementation of crowns and inlay/onlay. Panavia F 2.0, for example, tests at 24 microns while Clearfil Esthetic Cement measures 22 microns.

StarFill 2B would compare to Variolink 2 and Clearfil Esthetic Cement as opposed to Panavia. Panavia which has adhesive monomers built in, Variolink and Esthetic Cement do not. So like with Variolink and Esthetic Cement, suitable restoration primers must be used.

Tooth: While any dual-cure adhesive should work, Danville recommends Prelude SE, used with bottle #3, Link.

Porcelain and other HF-etchable ceramics: After HF etching, a silane such as Danville S-Bond should be applied.

Zirconia and Alumina: Sandblasting followed by application of Danville Z-Bond or Bisco Z-Prime.

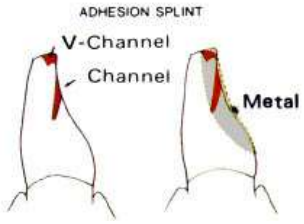
Metal: Metals should be sandblasted and then tin-plated or alternatively primed with a dedicated primer such as Tokuyama's Metaltite. (Caution: this is a reasonable bond but not as strong as Panavia or Bistite on tin-plated metal so it should not be used for critical applications. It is expected to be fine for crowns.)

Adhesion Bridges

The metal alloy and the design of the retainer greatly influence the long term function of adhesion bridges. Clinical success has convinced me that shallow retentive grooves and stiff metal are the keys to success. (I use Shofu size 170 Hybrid Point (Shofu product number PN0921-3, available from Schein) to place the grooves.) Existing restorations should generally be removed and can be a part of the retention and resistance design.

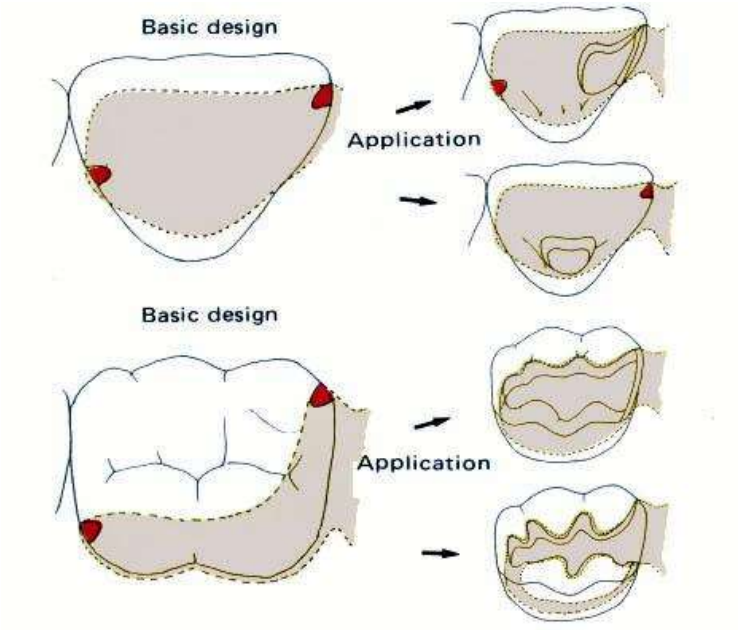
Non-precious nickel chromium alloys (such as Rexillium III or IV), when sandblasted, have the advantages of direct adhesion to Panavia F 2.0 and increased stiffness compared to precious alloys. (It takes 1.4x the thickness of nickel chromium alloy to get equal stiffness in a gold alloy and even more for palladium.) For anteriors, use the opaque shade of Panavia (OP) or Bistite 2 DC to prevent metal show-through.

These designs follow those proposed by Professor A. Yamashita. An imaginary line is drawn from the center of the proximal surface at the side of the missing tooth through the abutment tooth axis. Grooves (channels) are cut outside this line, mostly in enamel. A bar connects the grooves and forms the incisal margin, generally ending the retainer short of the incisal margin (ignoring the channel there) except in perio cases where I may use the incisal channel. A cantilever design is used to replace lateral incisors. It is essential to have the promixal grooves (channels).



In the Basic design of posterior retainer, grooves are placed in the area beyond the buccal line angle proximal to the missing tooth and the lingual line angle opposite to the missing tooth side. A bar connects the grooves.

Caries or a previous restoration can alter the basic design.



Cerec bonding and IDS

- **Prepare tooth by removing caries and any structurally compromised tooth structure.**
- **Apply primer (Prelude Primer #1), air dry, and apply bonding agent (Prelude Adhesive #2), dry and light cure.**
- **Apply a layer of Clearfil Photo Core (or Accolade SRO) and light cure.**
- **If any areas of Photo Core (or Accolade SRO) will not have the oxygen inhibited layer removed by refining the preparation, apply Liquid Lens and light cure again.**
- **Do the final cavity preparation in a "bath tub" design. Clean off enamel margins for optimal adhesion.**
- **Optical impression.**
- **Microetch with 27 micron aluminum oxide to remove powder.**
- **Etch preparation with liquid phosphoric acid, wash, dry.**
- **Apply Clearfil Porcelain Bond to sandblasted composite surface and to etched tooth. (Prelude #2 with Clearfil Activator and light cure is equally fine.)**
- **Apply Panavia F 2.0 to restoration (prime the restoration as necessary)**
- **Seat restoration, being sure to avoid trapping air.**
- **Brush off excess Panavia and light cure the margins.**

Pulp Caps using MTA (Tulsa Dental)

- Clean cavity preparation with 5% NaOCl (such as Chlorox) for 60 seconds or more, on cotton, wash off
- Place mixed MTA (MTA plus sterile saline OR anesthetic) over pulp exposure to allow a 1-2 mm thickness over site
- Place wet cotton pellet over the soft MTA
- Allow 24 hours for MTA to harden
- Place a non-eugenol temporary restoration
- 24 + hrs later: Remove temporary and place bonded filling as usual

- **Alternatively, a one appointment procedure:**
  Place RMGIG (Vitrabond, Fuji 2 LC, etc.) over soft MTA and light cure
- Please bond and composite as usual

Porcelain Veneer speed-bonding

This is a specific procedure which utilizes Accolade PV's unique Try-in composite (patent pending). To obtain the absolute maximum try-in time, use the directions that are in the Accolade PV kit. In those directions, no light curable bond is placed on the silane. Instead only Accolade PV Try-in is used and then later mostly removed by dissolving with Prelude #2. That procedure is excellent but I choose to use my Clearfil Photo Bond routine here, due to its long track record and dual-cure. I do in theory sacrifice some try-in time due to the light sensitive coat of enamel bond on the veneer but it has not been a clinical problem.

1. Before trying in the veneer, apply a hydrolyzed silane [Rely X (3M), S-Bond (Danville)] to the uncontaminated, HF etched veneer. Follow the silane manufacturer's instructions (sometimes an acid wash is necessary with the particular silane but not with 3M or Danville, a great convenience).

   Next, coat the silaned veneer with an unfilled, light curing, "enamel- bonding" resin [Enamel Bond (3M), DE Bond (Bisco), Visar Seal (DenMat), or E-Bond (Danville)]. Don't cure. Avoid dual cured resins, especially Clearfil Photo Bond, for this step in substitution for the light cured one since they may cause premature composite setting problems. The silane is now "locked in" by the unfilled resin and is permanently attached, unless dissolved in solvents such as alcohol.

2. Try the resin coated porcelain veneers for fit both individually and in adjacent groups on the unetched teeth. The unfilled resin protects the silane from contamination. After try-in, just brush off the resin with a dry brush, if contaminated, and brush on fresh resin. (In extreme cases, ultrasonically clean the veneer in ethyl alcohol and begin again with the silane step.)

3. Choose the desired shade of Accolade PV Try-in composite and place on inside of veneer to check shade on unetched tooth. [*If you are not using Accolade PV, you will need to follow the manufacturers directions for try-in paste, especially noting how it is removed after try-in.*] Be careful to avoid desiccation of the teeth to avoid a color shift.

   I usually try-in Accolade PV Try-in "Translucent" shade first; it is acceptable about 90% of the time. If the color needs to be modified, remove the veneer. Just wipe off the first try-in composite with a clean brush and change to the new shade. Try-in again. I find that when the first try-in does not produce an acceptable shade, slight white opaquing is usually needed (the tooth shows too much). Accolade PV has two excellent pre-opaqued whitish "veneer shades", Light and Extra Light, which greatly simplify this procedure. They usually eliminate the need for a custom mix. One of these two shades nearly always produces an acceptable try-in when the Translucent does not. In the rare event that the veneer needs darkening, just use a dark shade of flowable composite or the Accolade Brown or Yellow shades, or perhaps a blend of these in Translucent. In addition to the 5 PV shades, Accolade PV has a White Opaquer shade that is intended for custom blending. It is a "super white

and super opaque" blending shade used at Danville to produce Light and Extra Light PV shades.

Especially to be avoided for veneers are relatively high viscosity composite resins. They require excessive pressure to seat the veneers (veneer cracking problems), easily tear and form bubbles (black staining problems later).

4. Isolate, when necessary, with retraction cord [Ultradent #0 cord preferred], immersed in Visine if necessary for hemostasis. (Visine will not form a black sulfide stain at the margin like Astringident and other ferrous sulfates do and it does not over-etch the teeth.)

5. Clean try-in resin off the enamel surfaces, using pumice in a rubber cup. Avoid gingival contact to prevent bleeding. A Kincheloe "Retract" instrument (Danville or Tin Man) is a handy way to protect and retract the gingival tissue. Rinse with water and dry with oil-free air.

6. Brush at least 50% or Accolade PV Try-in composite off the veneers and replace it with the fully catalyzed Accolade PV of the desired shade.

(Note that when using Prelude SE following Danville's instructions, Prelude Primer is used on the Microbrush to rid the veneer of the Try-in Composite and to reach the silane layer. If you have coated the silane with an unfilled resin, step 1, just use a dry brush.)

7. Isolate teeth to be veneered with interproximal strips or Teflon tape to protect adjacent teeth (not being veneered) from the etchant.

8. See next step if using a self-etching system such as SE Bond or Prelude SE. Otherwise phosphoric acid etch tooth, wash and dry (assuming Clearfil Photo Bond is being used).

9. Place a thin coat of Clearfil Photo Bond on the etched tooth and blow off solvent.

If the prep is all or mostly all dentin and the veneer is fully light curable, then you may use self-etching Prelude SE rather than etch and Photo Bond. Also possible is total etch followed by Prelude #2 only. Also Clearfil SE Bond works well. Note that with SE Bond, everything must be cured at once; no pre-curing of the SE Bond is permitted since it extreme thickness would preclude proper veneer adaptation to the tooth. Prelude SE, being much thinner, may be light cured in advance of placing the veneer (air dry before curing) which is highly desirable.

10. Remove matrix strips prior to placing veneers on teeth. This step assures complete and passive seating of the veneers, even in multiples.

11. Gently place the veneers on the tooth, preferably all at the same time, and tack in center with small curing light perpendicular to facial surface, avoiding the margins. (The 3 mm diameter Demetron tip is ideal and takes 2-3 sec to spot cure.) After tack has fully cured, cure the other margins for about 1-2 seconds. Remove the resulting "jello" using a curette. Slide a metal matrix band mesial and distal of one tooth at a time and cure. The metal bands should be placed at the mesial and distal contacts of each tooth individually, preventing difficulty due to additive thickness of more than two bands at a time.

To be avoided is placing a matrix prior to placing the veneer on the tooth. Pressure from the matrix will push on the veneer, forcing

compensating seating pressure which results in broken veneers. If absolutely necessary, plumber's teflon tape makes a good matrix.

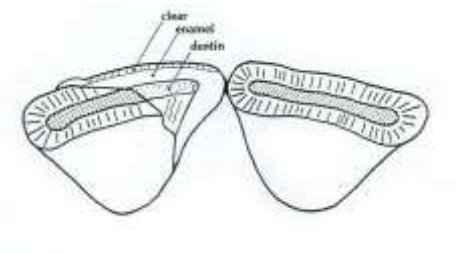
12. Cure the entire veneer fully (slowly at first) with the matrix bands removed. Avoid high intensity lights such as PAC lights unless you desire the look of "characterized", cracked veneers.

13. Finish gingival margin resin flash with a "new" twelve fluted carbide bur (usually a 7901), if necessary, and finish interproximal with G-C New Metal strips 600 grit (GC Dental). For the gingival margin areas, Danville's Stainbuster also works very well to remove any excess composite with no risk of damage to the veneer or tooth.

14. Polish exposed margins using thin, flexible polishing discs. Diamond "Flexis" disks (Vident) work well when it is necessary to trim or reshape the porcelain. Use rubber porcelain polishing cups/points such as Brasseler's "Dialite" cup and wheel to polish the porcelain.

Sectional Porcelain Veneers

Sectional veneers require translucent (almost transparent) porcelain at the visible margins for effective esthetic blending with the substrate. The lab should be instructed to place extra porcelain past the margin; you finish it after bonding it. The substrate can be a tooth or a porcelain restoration with a chip. (If metal shows, it is far better to use the porcelain/metal overlay technique.) Three essential tools are required: Flexis Discs (Mizzy) for porcelain trim and contouring and, if the substrate is porcelain, Clearfil Porcelain Bond "Activator" to mix with SE Prime or Photo Bond and a sandblaster such as a Microetcher.



Procedures for bonding sectional porcelain to: 1. tooth, 2. porcelain:

1. Bonding to tooth
If bonding to tooth, proceed with instructions for veneers. The variation required for sectional veneers is to contour and polish the sectional veneer after bonding it to the tooth. This contouring and finishing removes surplus porcelain placed by the lab to "temporarily" reinforce the margin areas. (These margins would otherwise be thin knife edge margins, impossible to fabricate or try-in without breakage.) The Flexis Disc, run at low speed is ideal. I like the medium grit. Then a Brasseler Dialite wheel restores the finish of the porcelain.

2. Bonding to porcelain:
The intraoral porcelain substrate is best bonded by using Clearfil Porcelain Bond Activator, mixed with either SE Bond Prime or Clearfil Photo Bond. The procedure is to sandblast the intraoral porcelain with 25 or 50 micron aluminum oxide, using around 40 psi of air. It usually takes 1 or 2 seconds. The sandblasted area is coated with normal enamel etch liquid (Danville's Star Etch is ideal) for a few seconds and washed well with water and air dried. Then the mix of Clearfil is applied (Activator plus either Photo Bond or SE Prime), air thinned, but not cured. If SE Bond Prime is used, it must be covered with SE Bond "Bond". It is ready to

receive the sectional veneer, coated with the usual silane, unfilled bond, and flowable composite.

It is usually best to have the lab etch the sectional veneer with HF since sandblasting tends to destroy thin margin areas. It is best to coat the etched area with a silane (such as S-Bond) rather than with Clearfil Porcelain Bond (Photo Bond plus Activator). The Clearfil tends to accelerate polymerization of the composite, cutting working time.

The veneer is bonded to the prepared porcelain substrate just like it is bonded to Photo Bond coated enamel except that Activator is added to the Photo Bond or SE Prime. Contour and polish the sectional veneer after bonding it to the intraoral porcelain. This contouring and finishing removes surplus porcelain placed by the lab to "temporarily" reinforce the margin areas. (These margins would otherwise be thin knife edge margins, impossible to fabricate or try-in without breakage.) The Flexis Disc, run at low speed is ideal. I like the medium grit. Then a Brasseler Dialite wheel restores the finish of the porcelain.

Removal of White Spots from Enamel

Superficial white spots are easily removed chemically. There is a commercial product, PREMA® Enamel MicroAbrasion, a chemical-mechanical polishing compound containing a solution of hydrochloric acid with silicon carbide in a water-soluble slurry. Hydrochloric acid requires a lot of safety measures so here is a safer, preferred alternative. It takes longer than PREMA but the time is made up by elimination of need for tooth isolation.

Make a slurry of ordinary phosphoric acid etchant jel with aluminum oxide, 27 or 50 micron. It should be the consistency of prophy paste. Just apply it with a Q Tip, rubbing it into the spot. It will usually take around 5 minutes. During the process, wash off the slurry and observe the result. I recommend stopping at about "3/4 removed" since further hydration will most likely make the spot disappear. Should the tooth be dried later, the spot will reappear but again go away with hydration.

Ceramic Failure Data

Data courtesy of Ken A. Malament DDS, Boston, MA

KAM ALL-CERAMIC RESTORATIONS
GROSS DATA TO JUNE 18, 2013

Ceramic	DICOR	IN-CERAM	EMPRESS	E MAX	TOTALS
Start	March 1983	February 1990	June 1992	May 2006	March 1983
Months	364	281	253	74	364
Patients	415	137	692	488	1733
Gross #s	1504	331	2130	1581	5546
Failures	240	49	100	1	390
Gross % Failure	15.96%	14.80%	4.69%	0%	7.03%
Chipping	4	13	31	4	512
Replaced	227	48	145	38	457

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