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CRA FIRST LOOK

CORE BUILDUP & ADHESIVE INCOMPATIBILITY

Clinicians are reporting lack of retention of some core buildup resins to some adhesives. Currently there is confusion & uneasiness because specific adhesive–core buildup incompatibilities have not been identified. Some have stated the problems are caused by combining light cure adhesives with dual or self cure materials. CRA data show the problem is not this simple. CRA's "First Look" tests using 7 popular core buildup materials with 24 adhesives show numerous exceptions to this statement. Furthermore, resin curing light–resin initiator incompatibilities also appear to be implicated. This report includes: (1) Core buildup & adhesive compatibility test results; (2) Procedures tested to enhance adhesive–core buildup bond; (3) Clinical considerations in core buildup procedures; & (4) CRA conclusions.

1. CORE BUILDUP & ADHESIVE COMPATIBILITY TEST RESULTS

Two dual & 5 auto cure core buildup materials were tested with the light cure form of 22 adhesives & the auto cure form of 2 adhesives representing popular brands &/or different formulations. Conventional halogen curing light was used (Optilux 500 @ 688 mW/cm²).

Shear bond strength (MPa) of 24 adhesives & 7 core buildup resins.

A ADHESIVE NAME ordered highest to lowest mean adhesion (CRA term for system type)	COMPANY	B FluoroCore Regular (Dual Cure)	C Core-Flo (Dual)	D LiteCore (Dual)	E Core Paste (Dual Cure)	F TI-Core Natural (Dual)	G TI-Core Duo (Dual)	H DentTastic (Auto)	I
1. Optibond FL (System 1)	Kerr	14.6	23.1	23.7	22.1	23.5	21.4	23.7	
2. All-Bond 2 (System 1)	Bisco	11.1	17.2	19.3	19.7	27.3	15.9	22.0	
3. Amalgambond Plus (System 1)	Parkell	10.5	20.1	15.8	20.5	17.5	13.7	17.1	
4. Clearfil SE Bond (System 1)	Kuraray	23.3	13.2	13.2	12.8	10.1	15.7	11.5	
5. Clearfil Liner Bond 2V (System 1)	Kuraray	18.2	17.4	15.3	16.9	10.6	11.1	10.0	
6. Tenure Quik (System 2)	Den-Mat	6.9	10.7	12.8	12.0	10.4	11.8	9.8	
7. EasyBond (System 1)	Parkell	16.2	12.6	10.0	10.2	10.6	12.0	5.1	
8. IntegrasBond (System 2)	Premier	10.0	10.1	10.4	10.7	12.4	8.6	4.9	
9. Mac-Bond II (System 1)	Tokuyama	13.2	9.1	14.6	16.0	2.6	2.1	3.3	
10. One-Step (System 1)	Bisco	8.8	7.0	6.9	11.2	8.7	10.3	6.7	
11. ED Primer & Panavia F (System 2)	Kuraray	6.7	6.9	7.6	9.0	7.4	8.3	6.5	
12. Single Bond (System 2)	3M	10.1	8.1	7.3	1.3	5.2	6.7	0.3	
13. Fuji Bond LC (System 2)	GC	6.7	11.4	5.1	8.1	5.7	7.0	2.4	
14. Gluma Comfort Bond + Desensitizer (System 2)	Heraeus Kulzer	7.4	10.0	3.1	5.0	7.2	8.0	2.9	
15. Cobrid (System 2)	Dioxus	10.6	5.5	8.6	0.8	3.4	3.1	1.2	
16. Gluma Comfort Bond (System 2)	Heraeus Kulzer	10.9	6.4	3.6	0.9	3.0	2.5	1.4	
17. Optibond Solo Plus (System 3)	Kerr	19.0	0.0	1.5	0.0	0.0	0.0	2.9	
18. PQ1 (New Formula) (System 2)	Ultradent	11.5	1.3	2.4	0.0	0.0	0.0	0.0	
19. Excite (System 3)	Ivoclar	6.3	3.4	1.2	0.5	0.0	3.4	0.0	
20. DenTastic Uno (System 3)	Pulpdent	7.2	0.0	4.8	1.7	0.0	0.0	0.0	
21. Prime & Bond NT (System 3)	Dentsply Caulk	10.6	0.0	0.0	0.0	0.0	0.0	2.0	
22. SnapBond (System 2)	Cooley & Cooley	6.7	0.0	0.0	0.0	0.0	0.0	3.1	
23. Multibond (System 3)	Centrix	3.9	0.0	0.0	0.0	0.0	0.0	0.0	
24. Prompt L-Pop (System 4)	ESPE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

Dual Core
Auto Core
Light Cure
Strengths 10 MPa or greater
Strengths less than 10 MPa
0 Bond Strength

CRA TERMINOLOGY FOR ADHESIVE TYPE

SYSTEM 1 = Etchant, primer, & adhesive all separate, ie: All-Bond 2.

SYSTEM 2 = Etchant separate, primer & adhesive combined, ie: One-Step.

SYSTEM 3 = Etchant & primer combined, adhesive separate, ie: Clearfil SE Bond.

SYSTEM 4 = Etchant, primer, & adhesive all combined, ie: Prompt L-Pop.

SUMMARY OF CHART:

A. No core buildup bonded to all 24 adhesives, but FluoroCore Regular bonded well with the largest number of adhesives (14 of 24).

B. Only 5 of the 24 adhesives bonded well to all 7 dual & auto cure core buildup materials. They were Optibond FL, All-Bond 2, Amalgambond Plus, Clearfil SE Bond, & Clearfil Liner Bond 2V. These include three System 1 & two System 3 adhesive types.

C. 6 of the 24 adhesives did not bond well to any of the 7 core buildup materials. They were ED Primer & Panavia F, Excite, DenTastic Uno, SnapBond, Multibond, & Prompt L-Pop. These include one System 3, four System 2, & one System 4 adhesive types.

D. 11 of 16 adhesives with primer & adhesive combined (System 2) bonded well to at least 1 core buildup material, & 3 brands (Tenure Quik, Easy Bond, & IntegraBond) bonded well to 5 or 6 of the 7 buildup materials.

E. Overall, these data indicate lack of adhesive–core buildup bonding is *formulation dependent*, & not due solely to incompatibility of light cure with auto & dual cure materials.

2. PROCEDURES TESTED TO ENHANCE ADHESIVE–CORE BUILDUP BOND

A. COUPLING AGENT PLACED BETWEEN CURED ADHESIVE & DEN-MAT'S CORE PASTE.

BondLink was just released by Den-Mat to improve bonds to their Core Paste. In CRA tests BondLink produced a 12.5 MPa mean increase for 9 of 13 low bonds with Core Paste shown in chart on page 1. Adhesives improved were #'s 12 & 15–22 (Single Bond, Cabrio, Gluma Comfort Bond, Optibond Solo Plus, PQ1, Excite, DenTastic Uno, Prime & Bond NT, & SnapBond). Adhesives not helped were #'s 13–14 & 23–24 (Fuji Bond LC, Gluma Comfort Bond + Desensitizer, Multibond, & Prompt L-Pop).

B. FLOWABLE RESIN PLACED BETWEEN CURED ADHESIVE & CORE BUILDUP.

Flow-it! flowable resin by Jeneric Pentron improved bond strengths by a mean of 7.8 MPa for Dentastic Uno & SnapBond with both Core Paste auto cure & FluoroCore dual cure buildup resins, but was either not helpful or very product specific for 8 other adhesives showing low bond strengths.

C. AUTO CURE CHEMISTRY ADDED TO LIGHT CURE ADHESIVES.

Several of the adhesives with low bonds to the core buildup materials tested have auto cure components that can be special ordered. CRA tested auto cure components for Cabrio, DenTastic Uno, Multibond, & Prime & Bond NT with Core Paste auto cure & FluoroCore dual cure buildup resins. Addition of this chemistry was helpful for Cabrio & DenTastic Uno, but not for Multibond or Prime & Bond NT.

SUMMARY: None of the 3 above methods used to increase adhesive–core buildup bonds provided an improvement for *all* adhesives tested. This again emphasizes that incompatability problems are formulation dependent.

3. CLINICAL CONSIDERATIONS IN CORE BUILDUP PROCEDURES

A. ADHESIVE CHOICE.

An important *clinical* consideration in selection of an adhesive for crown preparation augmentation is lack of sensitivity. Adhesives showing good bonds to core buildup materials in this report which are well known by clinicians for lack of post-operative sensitivity are: 1) **Amalgambond Plus**, 2) **Clearfil Liner Bond 2V**, & 3) **Clearfil SE Bond**.

B. CURING LIGHT CHOICE.

Tests showed 12 of the 24 adhesives studied exhibit varying degrees of curing problems. Inadequate adhesive polymerization could contribute to core buildup retention problems. As expected, some narrow bandwidth lights either cure slowly or not at all, but lack of cure was also noted with *conventional halogen* lights for Prompt L-Pop & Multibond, indicating these formulations need modification.

ADHESIVES THAT CURED WELL, REGARDLESS OF LIGHT TYPE OR BRAND USED

All-Bond 2	One-Step
Clearfil Liner Bond 2V	Optibond FL
Clearfil SE Bond	Optibond Solo Plus
Easy Bond	Prime & Bond NT
Mac Bond II	Single Bond

ADHESIVE–CURING LIGHT COMBINATIONS SHOWING PROBLEMS

Resin cured slowly
Cure required longer than recorded
Resin did not appear cured & had very low bond strength

	AccuCure 3000 Laser	Apollo 95E 470 bp	Apollo 95E 430 bp	Virtuoso	Optilux 501	Control 400 mW/cm²
	Narrow bandwidth	Narrow bandwidth	Narrow bandwidth	Broad bandwidth	Broad bandwidth	Broad bandwidth
Gluma Comfort Bond						30 sec
Fuji Bond LC	15 sec					
PQ1 (New formula)	20 sec					
SnapBond	25 sec					
Tenure Quik	15 sec					
Intrigraflora	15 sec				15 sec	
Gluma Comfort & Desensitizer	20 sec*	15 sec*	15 sec*	15 sec*	15 sec*	30 sec*
Cabrio						
DenTastic Uno						
Excite						
Prompt L-Pop			15 sec			
Multibond						

* Oxygen inhibition of thin layer contributed to slow cure

C. CATEGORIES OF CROWN PREPARATION AUGMENTATION.

(1) FILLER

LESS THAN ⅓ OF TOOTH PREPARATION MISSING ON A VITAL TOOTH. This is the most commonly occurring augmentation need. Technically this is a replacement for *previous* amalgam or composite resin. Mechanical retention usually is not necessary. Bonded compomer is the easiest restoration. Only moderate strength is necessary, but desensitization is mandatory. Use of one of the 3 adhesives listed in Section A above is indicated, or others (used properly) with green code on page 1.

(2) BUILDUP

MORE THAN ⅓ OF CORONAL TOOTH STRUCTURE IS MISSING ON A VITAL TOOTH. This situation occurs less frequently, because of the increase in cement strength over the past few years. Retention is augmented with "pot holes", grooves, channels, & if necessary, pins. Bonded composite is the easiest & best solution. High strength, bond, retention, & desensitization are all mandatory. Use of one of the 3 adhesives listed in Section A above is indicated, or others (used properly) with green code on page 1.

(3) POST & CORE

MORE THAN ⅓ OF THE CORONAL TOOTH STRUCTURE IS MISSING ON A NON-VITAL TOOTH. This situation is increasing because more teeth are retained longer & endodontic therapy is more common. Anti-rotational features can include "pot holes", grooves, channels, & if necessary, pins. Bonded composite resin is the easiest, best, & most popular technique. High strength, bond, & retention are mandatory. Use of an adhesive with consistently high bond strength to core buildup materials, such as Optibond FL, is indicated, or other adhesives showing high bonds in chart on page 1.

4. CRA CONCLUSIONS

Adhesive–core buildup bond incompatibilities were formulation dependent. There were enough exceptions to the statement that light cure adhesives do not bond to auto cure & dual cure core buildup materials to negate usefulness of this "rule". Optibond FL had best adhesive–core buildup strengths. Adhesives with best *combination* of good adhesion to all 7 core buildup resins tested, plus low clinical sensitivity were: Amalgambond Plus, Clearfil Liner Bond 2V, & Clearfil SE Bond.