Adhesive Dentistry 2013

...How do I stick this to that?
Welcome to Denver!

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Dr. Wilson does not have any financial interest in any of the products mentioned in this presentation.
In a time of drastic change it is the learners who inherit the future. The learned usually find themselves equipped to live in a world that no longer exists.

Eric Hoffer (1902-1983)
2013 Update

Dentin and Enamel Adhesion
Dentin and Enamel present conflicting challenges
Forces from occlusion and/or tooth flexure challenge the bonds
Forces generated within the restoration challenge the bonds
Dentin is variable
Elimination of solvents prior to polymerization
Appropriate control of moisture
  - From oral environment
  - As provided by DDS
Deciding which product to use!
How do we make decisions?
How do we make decisions?

Divine Guidance?
Evidence Based Dentistry
What does the future hold?

- If we are to be Clinician/Scientists rather than “Cosmeticians with first aid skills”* it is imperative that we become more sophisticated in our integration of valid scientific evidence with our clinical experiences and intuition.

- “Works in My Hands”, isn’t good enough!

Evidence Based Dentistry

Evidence-based dentistry (EBD) is an approach to oral health care that requires the judicious integration of systematic assessments of clinically relevant scientific evidence, relating to the patient's oral and medical condition and history, with the dentist's clinical expertise and patient treatment needs and preferences.

*ADA Policy on Evidence Based Dentistry, June 2002*

The integration of the best research evidence with clinical expertise and patient values.

*Sackett et al. Evidence-Based Medicine, 2000*

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**Levels of Scientific Evidence**

- *Systematic Reviews* (Strong Evidence to Support the Recommendation)
- *Randomized Controlled Trials*
- *Cohort Studies*
- *Case Reports*
- *Narrative Reviews, Expert Opinions, Editorials*
- *Animal and Laboratory Studies*
Evidence Based Dentistry
Where are we now?

- Due to the lack of long term studies of good quality coupled with demands for increasingly esthetic materials, these materials are brought to the market without sufficient clinical trial.
- WE become the “beta-testers” for many new products!
- This is expensive and frustrating!
The measure of success is not whether you have a tough problem to deal with, but whether it is the same problem you had last year.

John Foster Dulles (1888-1959)
Where have we been?

- Luting only
- Adhesion to Enamel
- Glass Ionomer Adhesion
- Generations 1, 2 dentinal adhesives
- Generation 3 systems (three bottles)
- Total etch procedures and 4\textsuperscript{th} generation dentinal adhesives (three bottles)
- 5\textsuperscript{th} generation (two bottles)
- Self-etching primers (6\textsuperscript{th}, 7\textsuperscript{th} – and up)
- Resin modified Ionomers
- Confusion
Where are we now?

Bonding is easy when you have the right chemistry.

Introducing the new Adper® Prompt™ L-Pop™ Self-Etch Adhesive.

Now with easier activation and improved chemistry. The only one-step, unit-dose, self-etch adhesive available today—is now improved to better meet your bonding needs. It offers a more reliable mix and better dentin bond strength. The adhesive also provides an aggressive enamel etch, and a higher viscosity that allows for a more uniform, consistent layer. Plus, it's still欧洲 to reduce post-operative sensitivity.

Best of all, you can count on its award-winning, single-patient L-Pop delivery system to enable you to mix, prime and bond in a single step—all in seconds. Or, if you prefer, the adhesive is also available in easy delivery: Adper Prompt™ Self-Etch Adhesive.

To order contact your 3M ESPE authorized distributor.

For additional information, call 1-800-328-1200 or

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Dentistry...the art and science
As we know,
There are known knowns.
There are things we know we know.
We also know
There are known unknowns.
That is to say
We know there are some things
We do not know.
But there are also unknown unknowns,
The ones we don't know
We don't know.

Feb. 12, 2002, Department of Defense news briefing
Enamel Bonding “known knowns”

- Very Predictable when done in isolation
- 35% Phosphoric Acid Etch
- More predictable when the surface is prepared
  - Prepare or “freshen” lightly
- Resin monomer application
  - Gently to preserve the prism formation
- Air Thin, Light Cure
- Complications occur when performing this task in conjunction with dentin bonding

We can see this clinically...only if we dry the enamel!
Enamel Only
Dentin bonding requires a “wet” environment
Dentin is an aqueous environment which is hostile to the resin
Solvents and water are ideally removed prior to polymerization
In combination the enamel is treated like dentin
The test of a first-rate intelligence is the ability to hold two opposing ideas in mind at the same time and still retain the ability to function.
_F. Scott Fitzgerald
Bonding to Dentin

- Complex arrangement of organic and inorganic tissue
- Varies in microstructure relative to location in the tooth
- Dentin is subjected to continuous physiologic and pathologic changes affecting its microstructure, composition, and permeability.

45,000 tubules/mm² near the pulp, 19,000
caries, scleroses, abrasion, erosion

*Lambrechts, Van Meerbeek, Perdiagão, Vanherle. Advances in Operative Dentistry, Chapter 9.*
Dentin Bonding 2013

- Bond Strengths approaching that of Enamel
- Predictability and Ease with which we achieve this bond highly variable
- Several classes of adhesives available
- Increasing evidence of poor durability with self-etching systems
- Lots of marketing, little long term clinical research
All of the mechanisms of composite resin adhesive systems rely on the production of a demineralized area with a remaining collagen fiber network followed by entanglement of the collagen with resin monomers producing a hybrid zone.
All of the mechanisms of composite resin adhesive systems rely on the production of a demineralized area with a remaining collagen fiber network followed by entanglement of the collagen with resin monomers producing a hybrid zone.
Layer of cutting debris and various "stuff"

Initially thought to be protective of tubules

May limit bonding

Not removed by scrubbing or rinsing

Removed by 35% phosphoric etch.

The question remains...do we remove the smear layer, leave the smear layer, or partially dissolve it and include it in the hybrid zone?
History of Medicine

- 2000 B.C. – Here, eat this root.
- 1000 A.D. – That root is heathen. Here, say this prayer.
- 1850 A.D. – That prayer is superstition. Here, drink this potion.
- 1920 A.D. – That potion is snake oil. Here, swallow this pill.
- 1965 A.D. – That pill is ineffective. Here, take this antibiotic.
- 2000 A.D. – That antibiotic is artificial. Here, eat this root.
1970-1990. – Protect the smear layer...removal will result in post operative sensitivity. Have eternal hope that something will stick to dentin.

1990-1999 – The smear layer must be removed...this is the gatekeeper of the dentin.

1999 – Present – The smear layer must be retained...it will prevent root surface sensitivity...However...

Future - ???
Adhesive Systems

Generations

• 1-3 No longer in the game
• 4-3 three bottle, total etch
• 5-3 two bottle, total etch
• 6-3 self-etch
• 7-3 self etch

By action

• More useful description

Dr. Van Meerbeek et al*


Introducing ibond

The first 7th generation bonding system.

Never mix again. Etch, disinfect, desensitize, prime and bond all in one step.

Meet ibond. The first truly one-step bonding agent for use with direct and indirect restorations. Now, you can save time and effort by etching, disinfecting, desensitizing, priming and bonding in a single step. No mixing. No mess. No worries.

How ibond works.

Unlike the total-etch, total-bond techniques, the self-etching bonding made possible by ibond does not open the dentinal tubules completely. The smear layer is solubilized and due to the high hydrophilic properties of ibond, it is then able to penetrate into the tubules and peritubular dentin forming resin tags. In the case of enamel, ibond produces a significant pattern with enlarged surface area, leading to improved enamel bonding.

Try the free single-dose sample enclosed and see how easy ibond is to use. For more information, please call 1-800-431-1785 or visit our website www.Heraeus-Kulzer-US.com

Heraeus Kulzer
Partnership First.
Those systems which remove the smear layer

- Three-Step etch-and-rinse adhesives
- Two-Step "one bottle" etch-and-rinse adhesives

Those systems which modify or dissolve the smear layer

- One-step no-rinse adhesives
- Two-step no-rinse adhesives

Three Step, etch-and-rinse systems, (fourth generation) All-bond 2, Gluma, Optibond, Scotchbond Multi-purpose... others

*Several coats of primer/resin necessary

Two Step*, etch-and-rinse systems, (fifth generation) i.e. Bond 1, Excite, Optibond Solo, Prime&Bond NT, Scotchbond 1, Tenure Quick, PQ1... others

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Dentin Adhesives

**One Step, No-rinse Systems,** i.e.

- **Two Step**, no-rinse systems, i.e.

  - Clearfil SE, Optibond (no etch), Simplicity, Non-Rinse Conditioner and Prime&Bond Clearfil SE
SE vs. TE... “known knowns”

- Best overall performance...etch and rinse, three bottle systems
- Highest technique sensitivity...etch and rinse, three bottle systems
- Lower technique sensitivity with SE


SE vs. TE... “known knowns”

- As simplicity increases, effectiveness decreases
- Only the two-step, self-etching systems approach the performance of total-etch systems
- Clearfill SE, most studied-best performance

Enamel bonding is compromised in self-etch systems

In many self-etch systems, dentin bond strengths exceed enamel bond strengths

Abo T, Uno S, Sano H. Comparison of Bonding Efficacy of an All-In-One Adhesive With a Self-Etching Primer System. *Eur J Oral Sci* 2004; 112 (June); 286-292
SE vs. TE… “known knowns”

- Enamel bonding is compromised in current self-etch systems
- Roughened enamel is better when self-etch is used
- Pre-etching enamel may compromise dentin bond in SE products
- Less predictable enamel bond in combination with “semi-permeable membrane” effect of more hydrophillic systems may result in more hydrolysis over time.


Many reports of reduced post-op sensitivity with self-etching systems

Many clinical studies indicating no difference in post-op sensitivity*


Evidence that total-etch systems bond better to sclerotic dentin*
Evidence that total-etch systems bond better to caries-affected dentin**
Glass-Ionomer restorative materials, liners, and bonding agents may be a better choice than any resin adhesive system
Does the enamel bond “stabilize” the dentin bond? (Both in terms of mechanics and seal)


SE vs. TE... “unknown unknowns”

Longevity...

- Does the apparent higher permeability of self-etch systems mean faster loss of bond?
- Does the water layer left in the hybrid zone with SE lead to degradation of the bond over time?
- Are these issues noted in in vitro studies clinically relevant?


SE vs. TE... “unknown unknowns”
Longevity...

- Does the apparent higher permeability of self-etch systems mean faster loss of bond?
- Does the water layer left in the hybrid zone with SE lead to degradation of the bond over time?
- Are these issues noted in in vitro studies clinically relevant?
- Evidence is still mixed!


Stabilization of dentin bonds with chlorhexidine?

- Application after etching has been shown in vitro to inhibit matrix metalloproteinases
- MMPs are intrinsic in dentin, released by etching, and can degrade collagen that is not encapsulated by resin.
- Galardin has also been demonstrated to inhibit MMPs

Current product (2%) Consepsis (Ultradent)

- Etch, rinse, CHX, dry to moist, primers and resin
- May eventually be incorporated into primers


In the SODM...

- We currently use Optibond solo, a etch and rinse system
- Uni-dose insures fresh solvents, better infection control, and reduced load on dispensary staff
- Self-etch not yet adopted due to questions regarding longevity
So...which one(s) do we use?

Two-Step (two bottle), total etch systems

- “Simpler” process
  - One fewer bottle

- Uni-dose packaging offers better control over the chemistry as well as significantly easier infection control

- Not “faster”
- Issue of “over-wet” or “over-dry” conditions
- Limited long term “in vivo” evidence
- No ability to use resin only

Two-Step (two bottle), total etch systems

As these solvent bottles are left open, the solution is changing by the second.
Questions relative to self-etching systems

- **Longevity of bond**
  - The smear layer, now incorporated into the hybrid layer may be subject to hydrolysis with time
  - The greater water absorption and water tree formation over time may reduce longevity of bond*
- **Effectiveness of enamel surface preparation**
- **Reduction in post-operative sensitivity**
- **Stay tuned!**

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What does the literature say about longevity?

- Systematic Review of clinical trials
- Retention of non-retentive class V restorations
- 1998-2004 / 85 qualified studies
- All Classes of adhesives
- GI > 3 step TE > 2 step TE > 2 bottle SE > 1 bottle SE*

* Not clinically acceptable

What about the new “Universal” Adhesives

- Scotchbond Universal™
- Bisco All-Bond Universal™
- Self-etch, Selective-etch, Total-etch
- Direct restorations – Indirect Restoration
What about the new “Universal” Adhesives?

- Best bond strengths – Total Etch Mode
- Then Selective Etch
- Then Self Etch
- Longevity?
- Offer possibility of use w/ indirect restorations
- NO MAGIC YET!
Enamel and Dentin have different and conflicting issues

Enamel bonding is not necessarily stronger but at this time is more predictable*

Newer single bottle and/or self-etching systems do not offer obvious improvements in performance* but may offer improvement in ease of use and lower technique sensitivity
No-Rinse products are increasingly showing less bond stability over time.

Two-step no-rinse systems perform much better than one-step systems.

Chlorhexidine has been shown to help stabilize bonds.

Nano-technology research may offer promise of bond stabilization.

Gold standard remains 3-step etch-and-rinse products.
Thank You!
Pre-Heating Composite

Pre-Heating vs. Flowable Composite
Pre-Heating Composite

- Calset™
- Claims
  - Better handling properties
  - Better adaptation
  - Improved conversion
  - Enhanced physical properties
Flow is increased
Does not achieve the film thickness of flowable
Polymerization shrinkage less than flowable
Degree of conversion improved
Physical properties significantly better than flowable, not clear that they are improved over non-heated composite


Cavity adaptation is improved
Modest improvement in physical properties
Less free monomer
Does not overheat pulp

If flowable is desirable...better choice may be pre-heated resin.
Only benefit proven to flowable is adaptation

Pre-Heating conventional composite resins offer better adaptation and more flow

Some evidence that physical properties exceed that of conventional composites

Significantly better properties than flowable composites

EXCELLENT ALTERNATIVE TO FLOWABLE COMPOSITE RESIN!
Thank You!
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