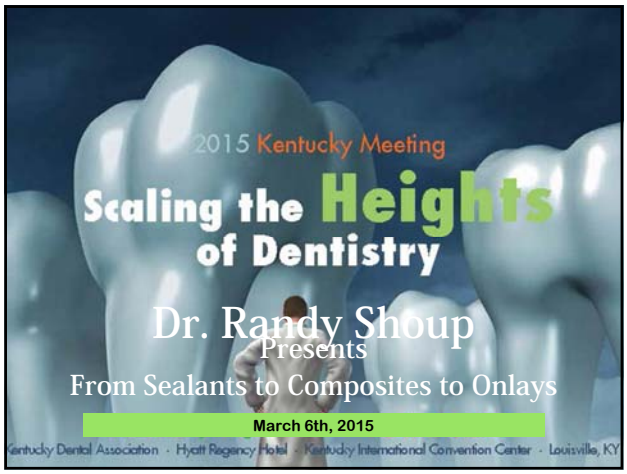

PHILOSOPHY

PHILOSOPHY MID.

What do you

BELIEVE ?

PHILOSOPHY MID.

“ This is important because our behavior is affected by our assumptions or our perceived truths. We make decisions based on what we *think* we know.”

Simon Sinek, Start With Why

PHILOSOPHY MID.

SUCCESS

vs

SIGNIFICANCE

PHILOSOPHY MID.

Philosophy of Minimally Invasive Dentistry

- The Practice of Dentistry is an Evolution of Technology, Biologic Science, and Materials Science
- Disease Prevention
- Preservation of the Maximum Volume of Healthy Tissue
- Long Lasting and Biocompatible Restorations

PHILOSOPHY MID.

Philosophy of MID

- Non Treatment is not an Option!
- There is No Place for "Watch" Today
- Each Patient is Part of a Defined Protocol
- Each Protocol is Based on Scientific Principles
- Protocols are an Extension of "Risk Assessment"

Philosophy of MID

- Minimally invasive is not about doing the LEAST amount of Dentistry!!!!!
- It's about doing the APPROPRIATE amount of treatment based on each patients

Risk Assessment

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Day Outline

Morning:	**Biofilms** **Sealants** **Biologic Seal**
Afternoon:	**Direct Composites** **Inlays & Onlays**

Day Outline - Thank You

Air Abrasion:
Crystal Mark
Mike Swan

Day Outline - Thank You

Microscope:
Global Surgical
Grover Knight

MICROBIAL BIOFILMS

Microbial Biofilms

- Collection of microbial organisms accumulated into communities.
- Communities adhere to any surface.
- The microorganisms reproduce, communicate, and exchange genetic material, and spawn new colonies.
- The communities are bound together by a protective mucopolysacchiride matrix.

Biofilms and Pathology

Direct Causation (80% of all Human Microbial Infections)

(CDC States 65% of all Bacterial Infections from Biofilms)

- Tooth Decay
- Periodontal Disease
- Device Related Infection and Joint Prosthesis)
- Cystic Fibrosis
- Chronic Non Healing Wound
- Otitismedia
- Cardiovascular Disease (Spirochetosis (I.V. W. Nordquist-The Stealth Killer
- Tonsilitis
- Osteomyelitis
- Urinary Tract Infection

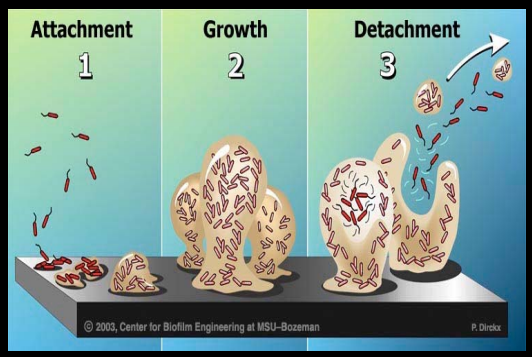
Biofilms and Pathology

Direct Causation (80% of all Human Microbial Infections)

(CDC States 65% of all Bacterial Infections from Biofilms)

- Bacterial Endocarditis
- Ulcers
- Catheter Infections
- Legionnaires Disease
- Cholera
- **MRSA (Methicillin Resistant Staph Aureaus) Vancomycin**
- Cardiac Devices
- Toxic Shock Syndrome
- BON (Bisphosphonate Induced Osteonecrosis)

Development and Anatomy of Biofilms



Dental Plaque as a Microbial Biofilm

Marsh, P.D., Caries Research 2004

"Biofilms express properties not exhibited by the same organism growing in liquid (planktonic) culture, while bacteria are invariably found in nature as part of a consortium, the properties of which are more than the sum of the component species"

Conjugative Pili:

"...They were able to capture a detailed series of images showing filament growth, attachment to other cells, and retraction to pull the cells together in preparation for genetic transfer."

Oklahoma Medical Research Foundation
Margaret Clarke, PhD., 2009

Dental Plaque as a Microbial Biofilm Marsh, P.D., Caries Research 2004

"The composition of dental plaque also varies on distinct anatomical surfaces (e.g. fissures, approximal and smooth surfaces, gingival crevice, dentures) due to the prevailing physical and biological properties of each"

"Approximately 50% of cells in plaque (especially from subgingival sites) cannot as yet be cultured in the laboratory"

"The biofilm acts as a selective permeable membrane and restricts ingress of antimicrobial agents, extracellular enzymes and noxious agents."

Garcia-Godox, Hicks
JADA Vol. 139, May 2008, p. 255

Dental Plaque as a Microbial Biofilm Marsh, P.D., Caries Research 2004

"Bacteria grown in dental plaque also display increased resistance to antimicrobial agents, including those used in dentifrices and mouth rinses. The biofilm inhibitory concentration for chlorohexidine and amine fluoride was 300 to 75 times greater, respectively when S. sobrinus was grown as a biofilm compared with minimum bactericidal concentrations of planktonic cells."

Effect of Biocides on Biofilm Bacteria From Dental Unit Water Lines Dept. of Microbiology and Molecular Genetics, University of the Punjab, Lahore 2007

They used:
Sodium dodecyl sulphate (SDS), Hydrogen Peroxide (H202), Sodium Hypochlorite (NaOCl), Phenol (PHE), Tween 20 (TW20), Ethylenediaminetetraacetic Acid (EDTA), Chlorohexidine Gluconate (CHX), Providine Iodine (PI),

Total Viable Count Effect:
PI: Negligible alone or in combination with CHX
NaOCl and PHE performed best as single or combination

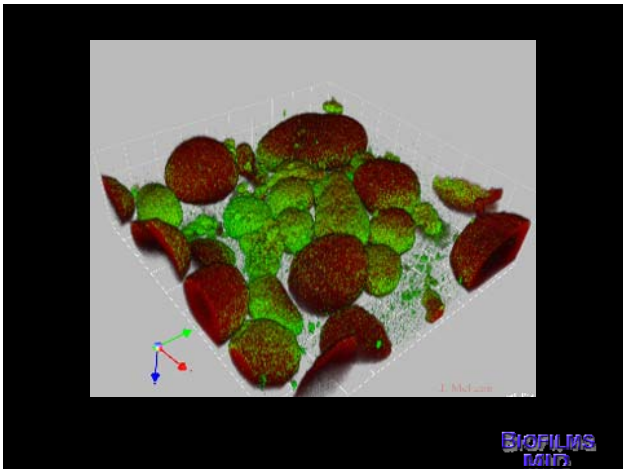
"Applying all biocides simultaneously did not completely eliminate viable bacteria nor did they remove biofilm"

Oral Surg Oral Med Oral Pathol Oral Radiol Endod, April 2008, Volume 105, No. 4

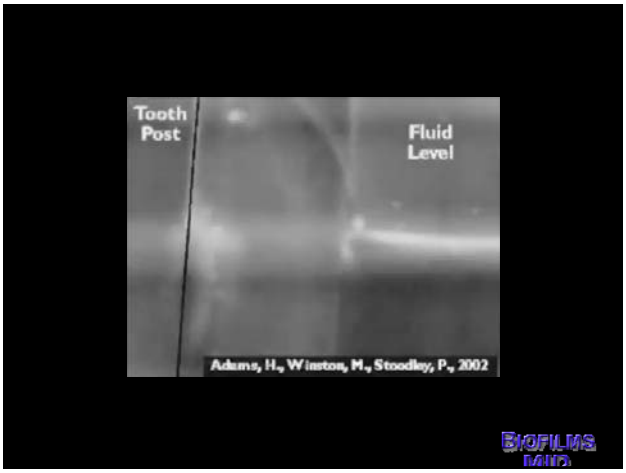
- 30 Extracted Human Teeth Diag. Necrotic With Periapical Lesions Prior To Extraction
- Used Wild Strain Bacteria To Grow Biofilms
- Exposed Biofilm to Ampicillin, Doxycycline, Clindamycin, Azithromycin, Metronidazole
- Biofilms Formed After 8 Days, Exposed The Biofilm To Antibiotics For 8 Days
- 5 Antibiotics Were "Entirely Ineffective Against Endodontic Bacterial Biofilm"

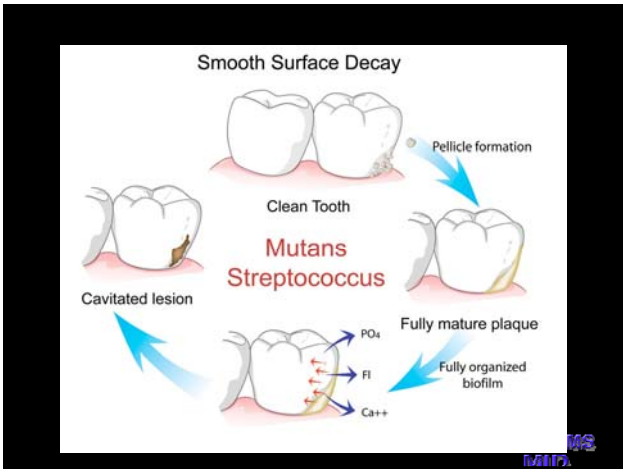
Montana State University: Center for Biofilm Engineering, Timothy Lu, Lemelson-MIT Student Prize 2007

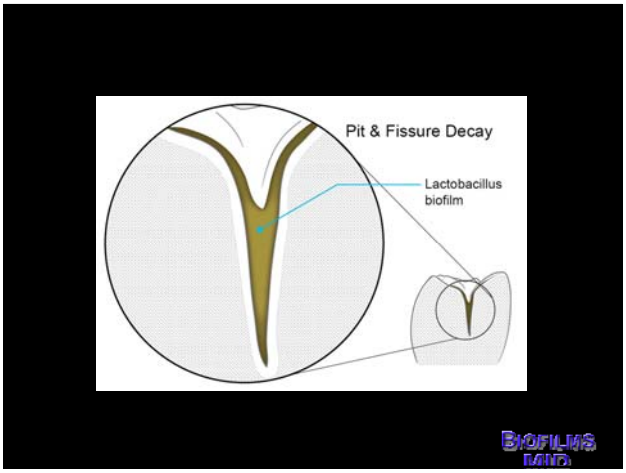
Created Bacteriophage platform. They destroy bacteria by injecting DNA into the bacteria, killing them. The bacteriophage also can make the slime layer more permeable to antibiotics.

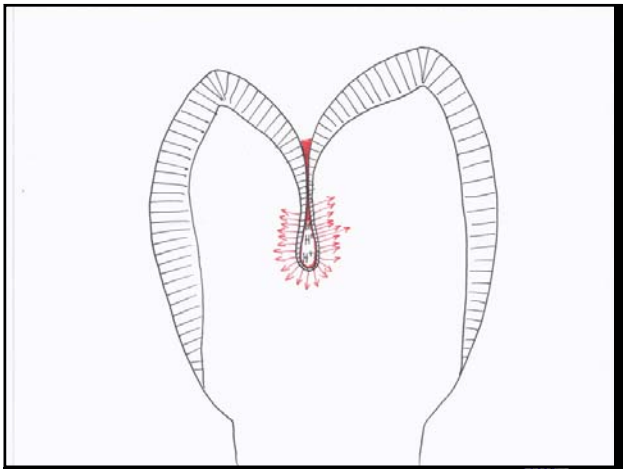


Ultrasonic Biofilm Destruction









Restorative Relevance:

- 71% of all restorative treatments are performed on previously restored teeth with recurrent caries as a predominant cause- Fontana, Gonzales-Cabezas, 2000
- 25% of Kids have 80% of the cavities
- 90% of all cavities are on the Occlusal
- 20% of the Population has 60% of the Decay –Anderson 2006

Restorative Relevance: Evidence-Based Clinical Recommendations for the Use of Pit-and-Fissure Sealants, Beauchamp, J et.al. JADA 2008

- 42% of Children 6-19 years old had caries
- 67% of Children 16-19 years old had caries
- About 90% of Carious Lesions Found in Pit and Fissures of Permanent Posterior Teeth
- About 44% of Carious Lesions Found in Pit and Fissures on Primary Teeth
- "It is generally accepted that the effectiveness of sealants for caries prevention depends on long-term retention"

Competitive Inhibition

- Healthy bacteria-"commensals"
- Strep sanguinis, Strep mitis, Strep salivarius
- Teughels at Catholic University Leuven, JADA 2007: Had a prominent inhibitory effect on the colonization of "bad" bacteria.

Hemi Section with Occult Decay

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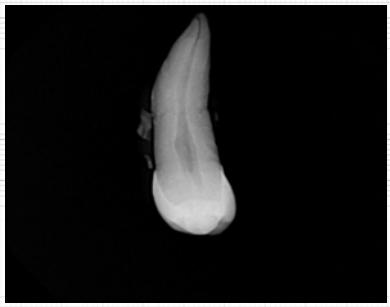

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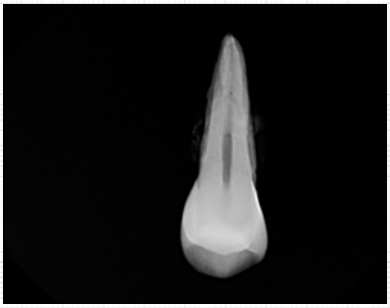

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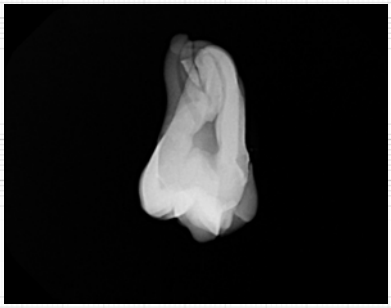

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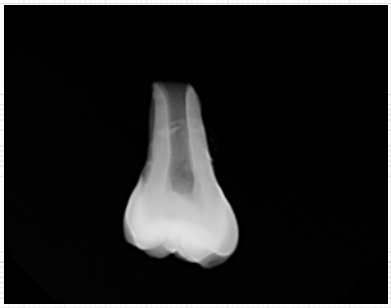

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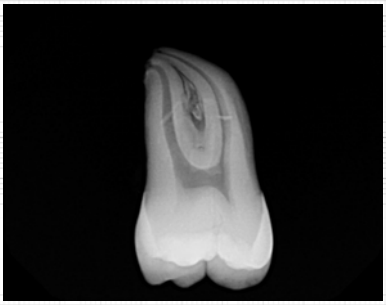

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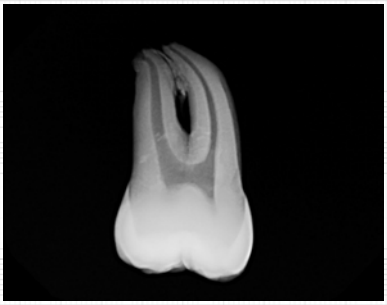

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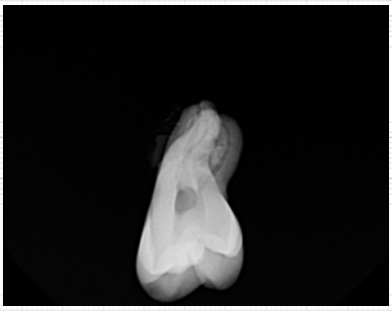

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Hemi Section with Occult Decay

What Do We Know?

- 90% of all decay occurs on the occlusal surfaces of teeth. (ADA 2008)
- 25% of the children have 80% of the decay ... 20% of the population has 60% of the decay. (Anderson 2006)
- Bacteria of choice is lactobacillus in a microbial biofilm in the grooves, pits, and fissures. (Montana State 2005)
- 71% of all restorative treatments are performed on previously restored teeth, with recurrent caries as a predominent cause.(Fontana et al. 2000)

We Also Know...

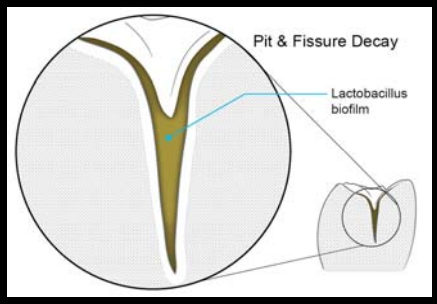
- Around 75% of the general population has some degree of dental phobia.
- Poverty is the single most powerful predictor of poor dental health.
- Fear is the best predictor of missed appointments. (Guedi, 2008)
- The most common issues that establish dental fear:
  Pain at previous appointment
  Initial trauma of treatment (Khan, 2004)

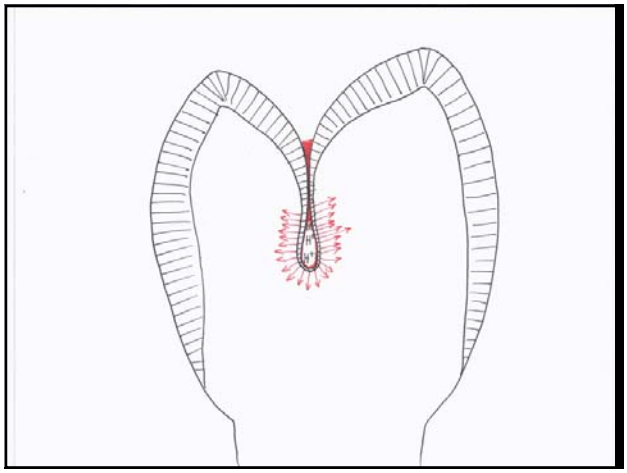
"In our study, most of the carious lesions for which restorative interventions were required involved the unrestored occlusal surface of permanent molars. In fact, the intricate fissure systems of occlusal surfaces usually are the first sites in the permanent dentition to develop caries. Occlusal surfaces remain a challenge area for caries diagnosis, in part because lesions on the surfaces appear to initiate on the fissure walls and hence can be masked by sound superficial tissue.."

Nascimento, Gordon, Quist et al
JADA, April 2010, Vol. 141, p. 446

"Of particular importance is the clinicians decision regarding when to place the first restoration on a previously unrestored tooth surface. The finite life span of a restoration suggests that premature operative interventions could lead to an early start of the life cycle which typically entails successive restoration replacements and reduced survival times."

Nascimento, Gordon, Quist et al
JADA, April 2010, Vol. 141, p. 441





Restorative Relevance:
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- About 90% of Carious Lesions Found in Pit and Fissures of Permanent Posterior Teeth.
- About 44% of Carious Lesions Found in Pit and Fissures on Primary Teeth.
- "It is generally accepted that the effectiveness of sealants for caries prevention depends on long-term retention"

H. Strassler, DMD; L. Guilherme Sensi, DDS - 2008:

"Caries has been identified as the single most common chronic disease of childhood. While caries on interproximal surfaces is decreasing, there has been a continuing increase in occlusal pit-and-fissure caries."

Compendium, October 2008, Volume 29, No. 8 p. 464

"Between 15% to 33% of teeth diagnosed as clinically sound were found to have hidden, trapped decay when evaluated histologically."

Weerheijm, KL et al, 1992
Aoba, T, 2004

Retention: The restoration exists and persists in its original position. It has not fallen out or been lost. The restoration may have leakage or frank decay around it.

vs.

Seal: The margins of the restoration are free of microleakage. The restoration exhibits no evidence of bacterial penetration, consequently there is no sign of recurrent decay.

A sealed restoration is always retained.

But

A retained restoration may or may not be sealed.

Thus

A sealed restoration is the goal.

Identification of Suspicious Areas

J Bader, D Shugars- 2007 META analysis
C Ketley- 1993
A Ouellet- 2002
J Hamilton- 2002

Conclusion:

1) "Thus within the limitations of the small number of dissimilar studies when dentists express uncertainty about caries status on occlusal surfaces, they are correctly interpreting the odds of dental involvement to be about 50/50."
2) "…the evidence describing progression of suspicious areas in the absence of any intervention is weak."
3) "When clinicians examine for early occlusal caries, regardless of the method or methods they use, they will miss a substantial proportion of these lesions, and will also misidentify a smaller proportion of sites being lesions, when, in fact, they are not."

Efficiency of Remineralization and Antimicrobials on Early Pit and Fissure Decay

B de Liefde- 1987
J Autio-Gold- 2001
F Florio- 2001
M Maltz- 2003

Conclusion:
"The evidence for the effectiveness of fluoride and other antimicrobials in halting the progression and promoting the remineralization of early caries on occlusal surfaces is scant…statistical significance was achieved in only 1 study." (Florio)

"It is far better to overtreat incipient lesions with sealants and preventive resin restorations than to not diagnose and leave the lesion progressing."

Hudson P.
J Am Dent Assoc, 2004

So Where Are We?

- We cannot predict who will and who will not get decay.
- 90% of the decay occurs on the occlusals.
- Occlusal decay resistant to remineralization/repair techniques.
- The tenacious nature of microbial biofilm seems to be the key element.
- Traditional methods of occlusal sealing entombs biofilm under the sealant.
- The older you get, the more likely you are to get occlusal decay.
- Restorative trauma starts and drives the fear cycle of avoidance.

"Fluorides, unless they are provided widely and consistently, are limited in their effectiveness against virulent dental caries... By the time the teeth are fully erupted and sealable, a sizable minority already have caries."

K. Ly, MD, P. Milgrom, DDS, M. Rothen RDH
JADA, May 2008, Vol. 139, p. 561

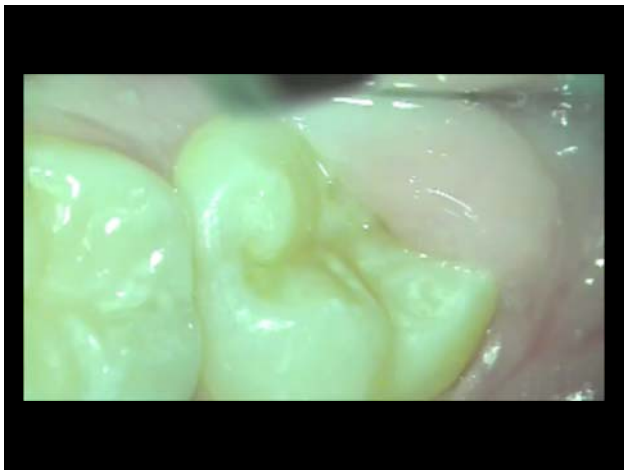
"Supervised tooth brushing of tooth surfaces before sealant application results in a similar level of retention associated with traditional handpiece prophylaxis."

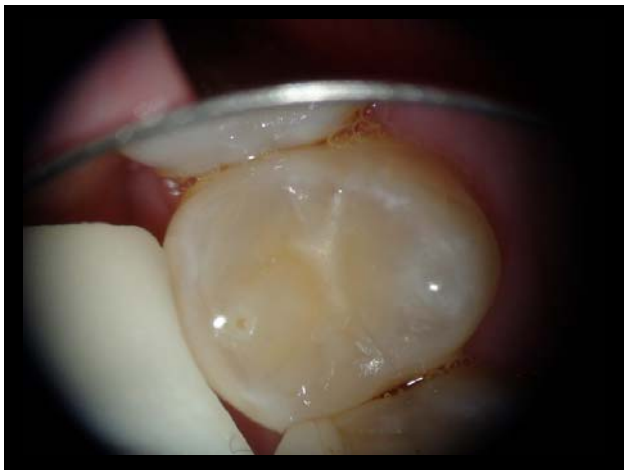
Farsai, Uribe, Vig
JADA, June 2010, Vol. 141, p. 697

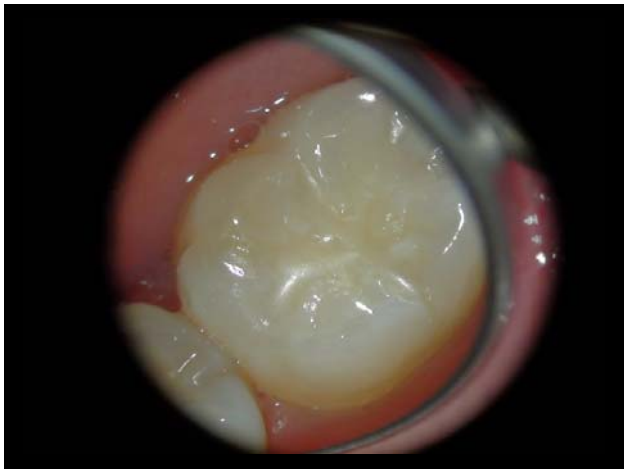
So What Will We Do?

- Air abrade the pit and fissures, removing the biofilm and existing decay in all occlusal surfaces of all molars and premolars.

  No biofilm ➹No decay
- Acid etch the enamel of the tooth.
- Use a primer/bonder system on the dentin.
- Use a fluoride containing flowable composite or GI to restore the teeth.
- Restore all teeth under rubber dam isolation.







SEALANT LIVE DEMO

AIR ABRASION

Biomimetic Dentistry

DIRECT COMPOSITE

Biomimetic Dentistry

Bio - "Life like"
Mimetic - "To duplicate or copy"

1.) Immediate Dentin Sealing (IDS)
2.) Resin Coating (RC)
3.) Biobase Layering (BL)
4.) Maximum Healthy Tooth Preservation
5.) Built-in Stress Dissipation in the Restoration

Biomimetic Dentistry - Immediate Dentin Sealing

Ultimate tensile bond strength of natural tooth at DEJ region
51.5MPa

Microtensile bond strength and biomimetic cementation technique
58.5MPa

Biomimetic Dentistry - Immediate Dentin Sealing

1.) Freshly cut dentin is the ideal bonding substrate
2.) Air abrasion of Fresh dentin will increase bond by 15%
3.) The selection of bonding system is critical
   100 systems worldwide
   56 systems in U.S. (Most don't work)
4.)Bonds must "mature" prior to being stressed

Biomimetic Dentistry - Immediate Dentin Sealing

Procedure (direct and indirect restorations)
Step 1.)Prepare the tooth with diamonds, remove decay, finish all shaping
Step 2.)Air abrade the entire dentin and enamel surface
Step 3.)Acid etch enamel only – 37% phosphoric acid
Step 4.)Deactivate the matrix metaloproteinases (MMPs)
Chlorohexidine, gluteraldehyde, ozone

Biomimetic Dentistry - Immediate Dentin Sealing

Step 5.) Slightly moist surface for primer agent. Multiple applications
Step 6.) Air dry primer so all solvent is evaporated
Step 7.) Immediately place bonding agent. Thoroughly wet the surface – DO NOT AIR DRY
Blot excess with micro brush – Cure 30 seconds

Biomimetic Dentistry - Immediate Dentin Sealing

From the cure light of the bonder 5 minute clock starts

In 5 minutes the bond will have matured to 75% of it's strength

Bonding Agents
You Want:
1.)Self Etching Primer
2.)Separate bonding agent – not ultra thin (<50microns)

Gold Standard: OptiBond FL, Clearfil SE, Clearfil Protect

3.) Acid etch enamel only!!

Biomimetic Dentistry - Immediate Dentin Sealing

Biomimetic Dentistry - IDS - Resin Coating

1.)Apply highly filled flowable to pulpal floor then axial walls
2.)Do not apply flowable to enamel surface
3.)Layer cannot exceed 1mm thickness
4.)Uniform coating over entire surface
5.)Cure 20 seconds
6.)Favorite: G-aenial universal flow GC America

Biomimetic Dentistry - IDS -RC - BioBase

1.) Composite Resin: Gradia, Filtek Supreme Ultra, Voco
2.)Each increment no thicker than 2mm
3.)C-factor

Configuration Factor

- Describes the surfaces that are available to participate in the bonding stresses and polymerization shrinkage.
- Ranks in order the strongest to the weakest bonding surfaces of the tooth structure.

C-Factor

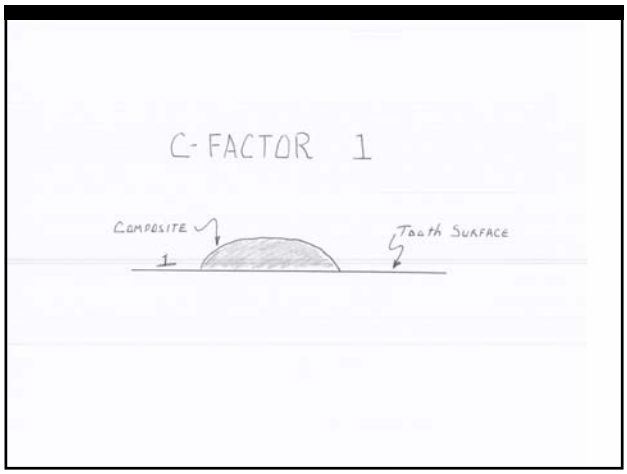
- Surface bond strength weakest to strongest:
- Pulpal Floor
- Dentinal Wall
- Dentin/Enamel Wall
- All Enamel
- Best to Bond from the Weakest to the

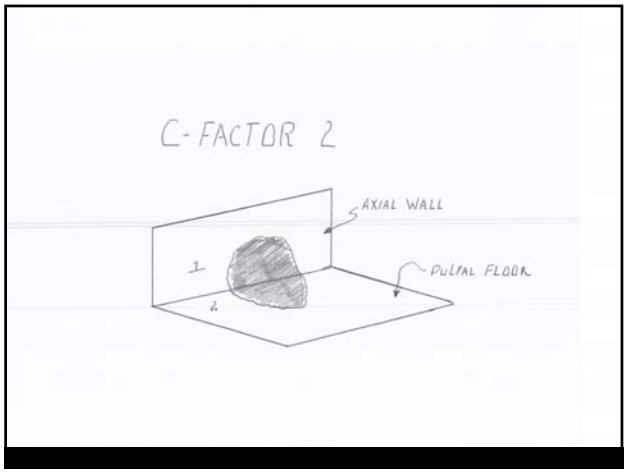
C-Factor

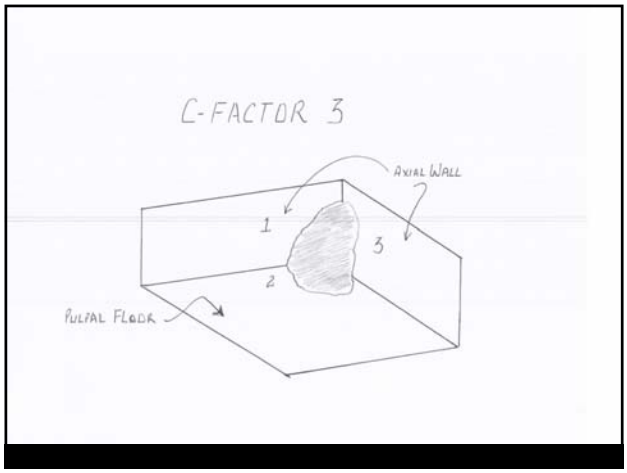
- G.V. Black NEVER worked with composite
- No sharp corners or angles
- The fewer the surfaces you bond at any one time the stronger the collective bonds to any surface are
- Bonding occurs on the side of the light source first then propagates through the composite

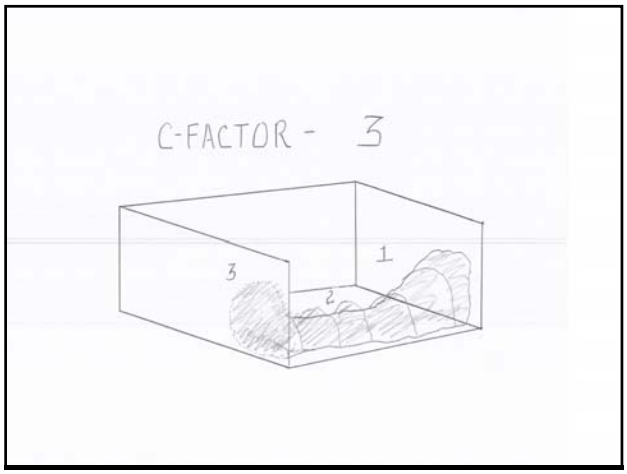
C-Factor

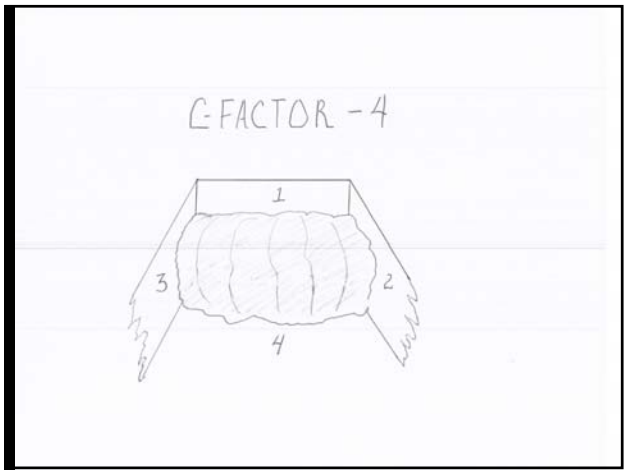
- Composite adheres to the surface with the strongest bond and contracts toward that surface
- Composite always occupies less space after it is cured. -it shrinks
- With the composites we have today, any BULK fill technique will fail!











David H. Pashley:

C-3 Lost 30% of bond strength
C-5 Lost 50% of bond strength
after simulated chewing cycle

NIH Study on Composite Survival

5.7 years

1) decay
2) fracture

Bonding

Young's Modulus of Elasticity

Elastic Modulus X % Shrinkage=
Bond Stress

Gel Phase of polymerization is critical for reducing bond stress

Bonding Systems

Fifth Generation Bonding Systems:
1) Self etch primer
2) Adhesive (bonder)
3) Best results to acid etch enamel
4) Allow bond to mature
5) Place Flowable over pulpal floor

Sixth Generation:
1) Single step prime and bond

Seventh Generation:
1) Etch, prime, bond all in one

Transudation:
The process of the hydrophylic primer allowing and fostering liquid from the dentinal tubules to accumulate on the surface of the primer prior to bonder placement.

Bond Maturation
For maximum strength the bond must mature for about 5 minutes prior to placement of the overlying composite. Critical on the pulpal floor.

MATRIX METALLOPROTEINASES (MMP'S)

Adhesive procedures activate the MMP's that degrade the hybrid layer collagen. Etching and priming seem to activate these enzymes in dentin and degrade the bond over time.

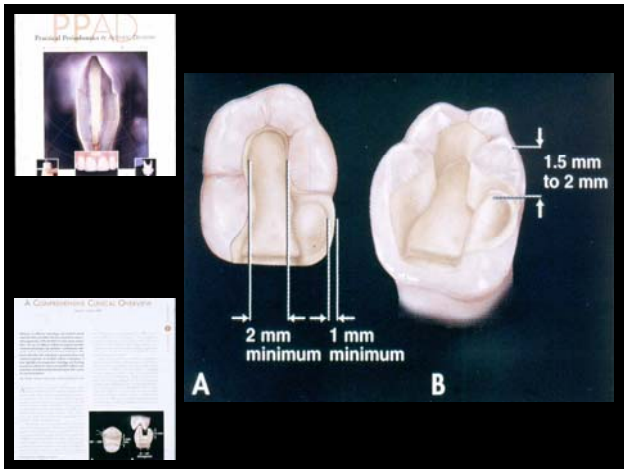
Chlorohexidine decreases bond immed. but then steady over time.
Gluteraldehyde increases bond immed. but then slowly degrades over time.

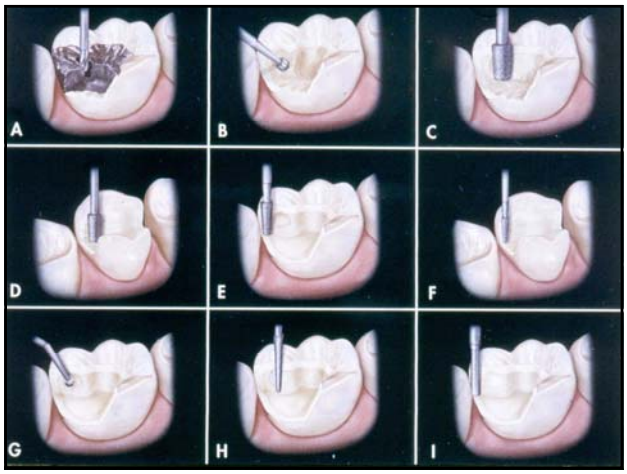
Biomimetic Dentistry

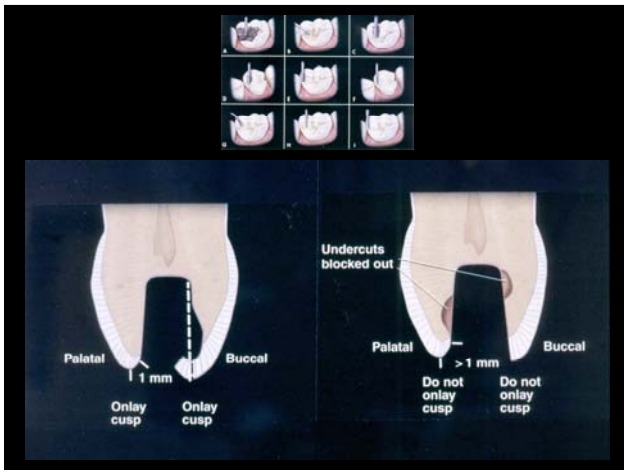
DIRECT COMPOSITE LIVE DEMONSTRATION

Biomimetic Dentistry

INLAYS AND ONLAYS







Material Selection

Gold - Longest Survival for Endo Teeth

CAD/CAM
- Zirconium - Hard to adjust, does not bond
- Lithium Disilicate - Easier to adjust, bonds
- Lava Ultimate - Easy to adjust, bonds

EXPERIENCE EXCELLENCE

INLAY, ONLAY AND CROWN PREPARATION DESIGN BASED ON CAD / CAM DESIGN

DR. RANDY SHOUP
www.drshoup.com

START

- Over 85% of Indirect Restorations are created by Scanning and Milling
- Dental preparation style has not changed since G.V.Black
- Traditional preparation guidelines are incompatible with Milling algorithms
- New ceramics have extremely critical and sensitive requirements for support and interna stress that if violated will lead to restoration failure

ISAAC ASIMOV'S 3 LAWS OF ROBOTICS

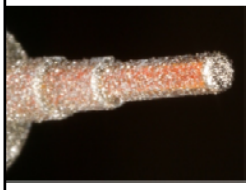
1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey orders given it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

3 LAWS OF CAD / CAM MILLING

1. The restoration must seat on the margins
2. If the mill cannot duplicate the scan it will "over mill" in order to obey the first law
3. The mill will sacrifice the integrity of the material in order to seat the restoration and to obey occlusal and proximal contact parameters

3 LAWS OF CAD / CAM MILLING

Milling Head Diamonds
Blunt end for internal / margins
Pointed end for occlusal / exterior



Internal Surface Diamond
1.6mm diameter cylinder

3 LAWS OF CAD / CAM MILLING

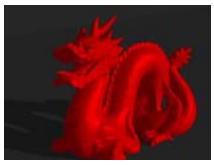
CEREC Lab Milling Head
4 Diamond system

Internal Surface Diamond
1.6mm diameter cylinder

3 LAWS OF CAD / CAM MILLING

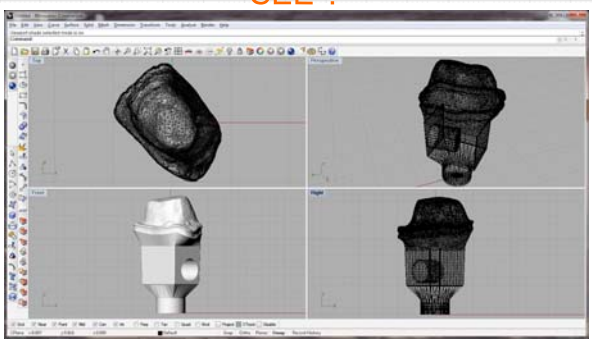
- Cannot mill a radius less than 1.8mm in diameter
- Cannot mill any internal line angle less than 100 degrees
- Cannot duplicate any topographical change less than 100 microns

WHAT DOES THE MILL ACTUALLY SEE ?



- **Grid of the triangles that the software can translate into commands to the mill head**
- **The triangles are created based on the 'best fit' that can be achieved knowing what the mill can duplicate**

WHAT DOES THE MILL ACTUALLY SEE ?

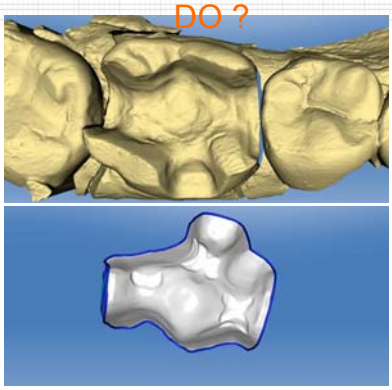


WHAT DOES THE MILL ACTUALLY SEE ?

WHAT DOES THE MILL ACTUALLY SEE ?

WHAT DOES THE MILL ACTUALLY SEE ?

WHAT DOES THE MILL ACTUALLY DO ?



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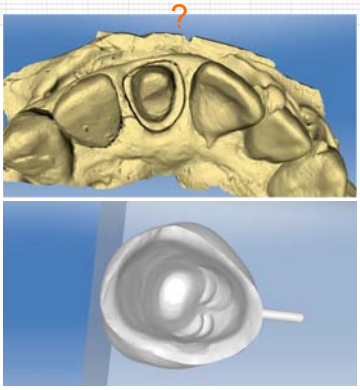

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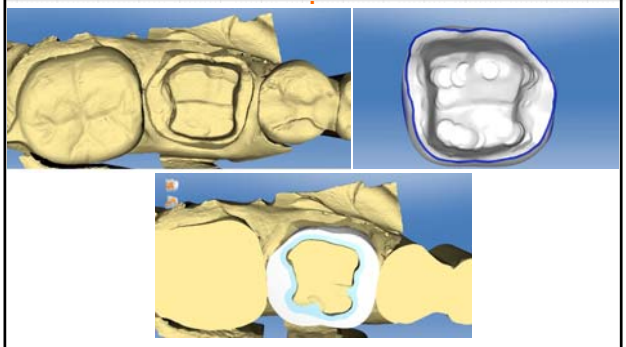

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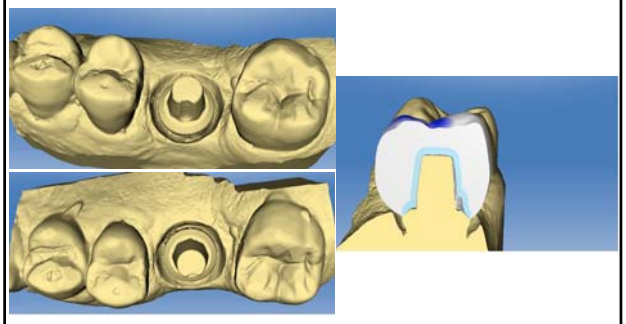

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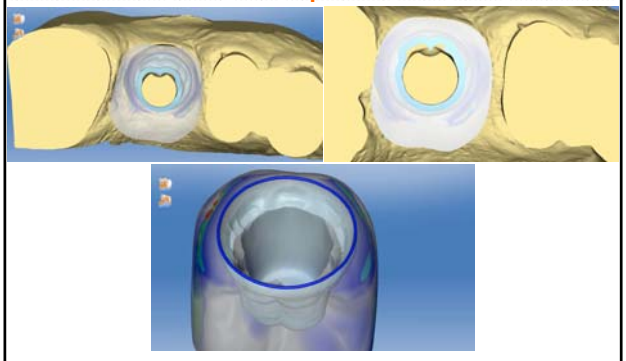


HOW TO CREATE A MILLABLE PREP ?

BRASSLER

5856 - 025

2.1 mm Diameter at the tip

HOW TO CREATE A MILLABLE PREP ?

BRASSLER

5856 - 0021

1.8 mm Diameter at the tip

HOW TO CREATE A MILLABLE PREP ?

BRASSLER

8856 - 020

1.8 mm Diameter at the tip

HOW TO CREATE A MILLABLE PREP ?

HOW TO CREATE A MILLABLE PREP ?

HOW TO CREATE A MILLABLE PREP ?

HOW TO CREATE IDEAL CONTOURS

- Proper size Diamonds
- Electric Handpieces
- Microscope
- Air Abrasion
- Ultrasonic Diamonds
- Constantly think about what the milling head will be able to and not able to cut

HOW TO CREATE THE PERFECT MARGIN

1. Gross prep with minimum of 4.0X and light
   Electric handpiece rotating 200,000 rpm at bur
   Course grit diamond
2. Refine prep margin with 16X scope and light
   Electric handpiece rotating 35,000 rpm at bur
   Red stripe finishing diamond
3. Margin polish with 16X scope and light
   Kavo sonic at setting "1" able to cut

COMPARISON OF PREPS ?

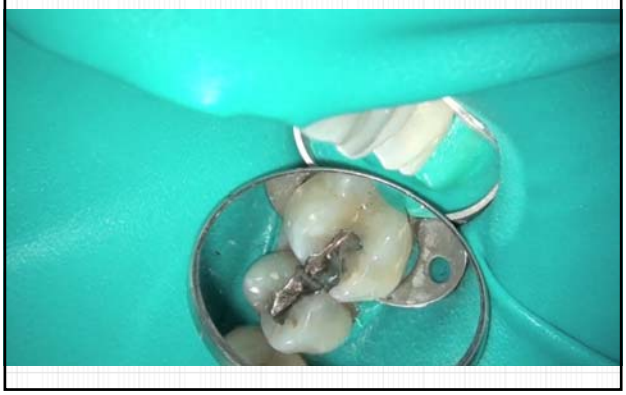
GROUP 1

GROUP 2

GROUP 3

GROUP 4

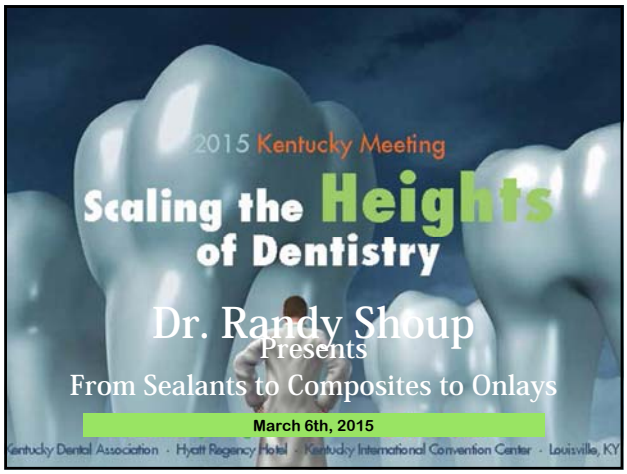
Biomimetic Dentistry - Immediate Dentin Sealing



Biomimetic Dentistry - Immediate Dentin Sealing

Biomimetic Dentistry

INLAY-ONLAY PREP DEMONSTRATION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Dr. Randy Shoup
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From Sealants to Composites to Onlays
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