Special thank you to

Richard Price, DDS, MSc, PhD
Professor, Prosthodontics
& Biomedical Engineering

DALHOUSIE UNIVERSITY
Inspiring Minds
Disclosure

- Advisory Board BlueLight Analytics
- San Francisco Giants fan
- Supporter of Baltimore Orioles
What are we light curing?

- Adhesives
- Restorative composites
- Sealants
- Ceramic veneers
- Ceramic inlays/onlays
- Fiber posts
- Bases-liners
- Tray materials
- Denture base materials
- Prosthodontic provisional materials
- Desensitizing agents
- Bleaching agents
Majority of direct restorations placed **Composite Resins**

- 130,054 General Dentists in US
- >122 million direct resin restorations
- **Plus veneers + orthodontics**

All used light curing!

ADA 2005-6 Survey of Dental Services
“Despite steady progress in learning how to better **formulate** and **cure**, or harden, dental composites... Studies have shown that dental resin **composites have an average replacement time of 5.7 years** due to secondary decay and fracture of the restoration.”
Understanding Light Curing
Science of light curing
Composite Use

- 122,666,950 direct resin restorations a year
  ADA 2005-6

- One third of dentists have eliminated amalgam.
  Christensen, Dental Economics Jan 2011

- In the last 12 months in the U.S., the ratio of composite placed compared to amalgam placed was two Class II composites for every one Class II amalgam.
  Limoli and Associates, Oct 2010
Did you know?

• 122,666,950 direct resin restorations a year: ADA 2005-6
• 50 working weeks a year x 5 days = 250 working days
• 490,667 resins a day
• 490,667 times a curing light was used
• 490,667 times @ $200 each
• $98,133,560 a day in the US ALONE
• $24.5 BILLION a YEAR
Light-curing... so easy a caveman can do it!
The Problem

Process of “light-curing” is treated with “little regard” to the exacting science it really is. “Too easy” and minimal attempts seem to produce an acceptably “hard” restoration.
Understanding the challenge

Teach students-clinicians how to use their light properly and what affects the extent of cure of THEIR RESTORATIONS:

What “spectral output” of the light means
What are the “spectral needs” of the resin
What is the difference between irradiance and energy density
How exposure duration and spectral delivery affect final restoration cure
The Problem:
not curing composite completely

- Lower bond strength
- Increased microleakage
- Increased recurrent caries
- Increased staining-color changes
- Increased wear

Premature restoration failure!
Not all curing lights are the same

Understanding The Differences
Power = mWatts
Irradiance
(Power/Unit Area) mW/cm²
Spectral Radiant Power
mWatts/nm

Irradiance 1735 mW/cm²

Wavelength (nm)

absolute Irradiance (mW/nm/cm²)

Spectral Radiant Power
mWatts/nm
Understanding

- Power: mWatts
- Irradiance: (Power/Unit Area) mW/cm²
- Spectral Radiant Power: mWatts/nm
- Energy Density = Irradiance x Time: 8 - 16 J/cm²

3M ESPE
Filtek™ Supreme Ultra
Universal Restorative

7. Curing: This product is intended to be cured by exposure to a halogen or LED light with a minimum intensity of 400 mW/cm² in the 400-500 nm range. Cure each increment by exposing its entire surface to a high intensity visible light source, such as a 3M ESPE curing light. Hold the light guide tip as close to the restorative as possible during light exposure.

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MARC (BlueLight Analytics)

- BlueLight makes MARC™—Managing Accurate Resin Curing.
- MARC™ was invented by Dr. Richard Price and his research associate, Chris Felix, at Dalhousie University.
- MARC™ is the first and only scientifically accurate, clinically relevant and easy-to-use energy measurement system for measuring what resin actually receives.
Who is MARC™?

MARC™ Patient Simulator quantifies energy delivery to resin

Scientifically accurate, clinically relevant & easy-to-use

Consistent calibration enables apples:apples comparisons
LIGHT SPECTRUM
Irradiance = 1,200 mW/cm²
Irradiance not uniform

What is the beam profile?

1200 mW/cm²  388 mW/cm²  5,834 mW/cm²

Price, Rueggeberg et al. J Esthetic and Restorative Dentistry 2010
Detects uneven beam distribution
hot spots-cold spots
Operator technique evaluation

Typodont head with detectors in teeth measure light received.
Bottom line...

How do we make the science relevant and create value during a student’s/clinician’s education?
For a clinical procedure
light curing = 15-60 sec
Understanding leads to improved clinical success

Light energy matters!
Safety concerns

Neurobehavioral effects of dental amalgam in children: a randomized clinical trial.


Department of Dental Public Health Sciences, School of Dentistry, University of Washington, Seattle, WA 98195, USA. derouen@u.washington.edu

CONTEXT: Dental (silver) amalgam is a widely used restorative material containing 50% elemental mercury that emits small amounts of mercury vapor. No randomized clinical trials have determined whether there are significant health risks associated with this low-level
Neuropsychological and renal effects of dental amalgam in children: a randomized clinical trial.

Bellinger DC, Trachtenberg F, Barregard L, Tavares M, Cernichiari E, Daniel D, McKinlay S.

Department of Neurology, Children’s Hospital Boston, and Harvard Medical School, Boston, Mass, USA.

CONTEXT: No randomized trials have been published that address the concern that inhalation of mercury vapor released by amalgam dental restorations causes adverse health effects. OBJECTIVE: To compare the neuropsychological and renal function of...
Doubts are raised on re-regulation

By Paul Adams

Re-regulating Maryland's power industry might be politically popular in the face of rising rates, experts say, but would be legally complicated, potentially costly and would not necessarily result in lower energy prices.

The idea of re-regulation has gained steam during the past month as the prospect of a 72 percent rate increase this summer by Baltimore Gas and Electric Co. all but consumed the recent session of the Maryland legislature.

On Monday, Douglas M. Duncan, the Montgomery County executive and Democratic gubernatorial candidate, called for re-regulating the power industry and imposing rate limits, setting himself apart from the other major candidates in the race.


Two bills introduced during the legislative session also called for some form of re-regulation to counter rising energy costs, but they faltered as officials focused on the more immediate problem of easing this summer's rate increase.

Ehrlich is negotiating with Constellation Energy Group Inc., the parent of BGE, on a possible phase-in for the rate increase. (Please see POWER, 7A)

Silver Fillings Found Kid-Safe

Traditional tooth care contains mercury but doesn't harm children, major studies indicate

By Jonathan Bor


CONCLUSIONS: In this study, there were no statistically significant differences in adverse neuropsychological or renal effects observed over the 5-year period in children whose caries were restored using dental amalgam or composite materials. Although it is possible that very small IQ effects cannot be ruled out, these findings suggest that the health effects of amalgam restorations in children need not be the basis of treatment decisions when choosing restorative dental materials.
Survivability
Amalgam vs Composite

CLINICAL PRACTICE

JADA Continuing Education

Survival and reasons for failure of amalgam versus composite posterior restorations placed in a randomized clinical trial

Mario Bernardo, DMD, PhD, Henrique Luis, MS, Michael D. Martin, DMD, MSD, MPH, MA, PhD, Brian G. Leroux, MSc, PhD, Tessa Rue, MS, Jorge Leitão, MD and Timothy A. DeRouen, PhD
Survival and reasons for failure of amalgam versus composite posterior restorations placed in a randomized clinical trial.

**Bernardo M, Luis H, Martin MD, Leroux BG, Rue T, Leitão J, DeRouen TA.**

Community and Preventive Dentistry, Faculdade de Medicina Dentária, Universidade de Lisboa, Portugal.

BACKGROUND: Failure of dental restorations is a major concern in dental practice. Replacement of failed restorations constitutes the majority of operative work. Clinicians should be aware of the longevity, and likely reasons for the failure of, direct posterior restorations. In a long-term, randomized clinical trial, the authors compared the longevity up to seven years. Overall, 10.1 percent of the baseline restorations failed. The survival rate of the amalgam restorations was 94.4 percent; that of composite restorations was 85.5 percent. Annual failure rates ranged from 0.16 to 2.83 percent for amalgam restorations and from 0.94 to 9.43 percent for composite restorations. Secondary caries was the main reason for failure in both materials. Risk of secondary caries was 3.5 times greater in the composite group. CONCLUSION: Amalgam restorations performed better than did composite restorations. The difference in performance was accentuated in large restorations and in those with more than three surfaces involved. CLINICAL IMPLICATIONS: Use of amalgam appears to be preferable to use of composites in multisurface restorations of large posterior teeth if longevity is the primary criterion in material selection.
Effect of Distance from the Light Guide on the Irradiance Received

When curing adhesives in deep proximal boxes with quartz halogen light (600 mw/cm²) curing time should be increased to 40-60 seconds to ensure optimal polymerization.

To maximize the energy delivered, the operator should wear eye protection, should watch what he or she is doing and should hold the light both close to and perpendicular to the restoration.

Price RB, McLeod ME, Felix C Quantifying light energy delivered to a Class I restoration J Can Dent Assoc 2010
Where is the light relative to what it is curing?
Orientation of the Light

**Right angle
**Close to the tooth as is possible

Matrix band moves
The light further away!
Mis-Orientedation of the Light

Note the height of the matrix
Lights not working optimally
MARC

Scientifically accurate - clinically relevant device.
Measures:
Irradiance
Spectral emission
Energy values
MARC for light curing training

Operator technique
Good light curing habits

CORE

Curing Light

Operator Technique

Restoration (location, depth, size, opening)

Energy Requirement
Know your Curing light
37 Operators
Same Light, Same Tooth, Same Time

Optimal is 8.0 J/cm²
Range from 0.9 – 7.2 J/cm²
Average was 4.1 J/cm²
Teaching and Evaluating Light Curing

Before Instruction

• NOT looking, NOT stabilizing,
• NOT wearing eye protection!

After Instruction

Wearing eye protection, looking, stabilizing!
After Group Instruction

Optimal is 8.0 J/cm²
Range from 5.8 – 7.6 J/cm²
Average was 6.7 J/cm²
Operator controlled
Light tip diameter of 7.5 mm

- Sealant on molar- 2 cycles (overlapping tip)

- Occlusal Class I- 2 cycles (overlapping tip)
- Class I or II premolar - 1 cycle
  no overlap needed unless the premolar is larger than normal

- Class II molar - 2 cycles (overlapping tip)
Facial of a maxillary central incisor two or four cycles with overlap

- Facial veneer
  - Direct composite
  - Porcelain veneer
- Class IV
- Light cure facial and lingual
- A maxillary lateral incisor two cycles

Curing porcelain veneers
Negative effects-Restoration
Light angulation-Light movement

A 30° angle can reduce energy delivery by 26%
Change the angulation
Change the cure
Energy requirement

- Power: mWatts
- Irradiance: (Power/Unit Area) mW/cm$^2$
- Spectral Radiant Power: mWatts/nm
- Energy Density = Irradiance x Time: 8 - 16 J/cm$^2$

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7 Steps to Ensure Better Light Curing

1. Wear orange glasses (blue light blocking) for safety and so you can watch what you are doing.

2. Re-position the patient so you can easily see the restoration and access it with the curing light.

3. Position yourself comfortably so you can stabilize the curing light directly over the preparation.
7 Steps to Ensure Better Light Curing

4. Adjust the light guide so you can operate the light comfortably. Clean the tip as needed.
5. Stabilize the curing light so the beam is perpendicular to the surface of the resin.
6. Begin curing 1mm away from resin and then move as close as possible after 1 second.
7. Air-cool or wait between each curing cycle; test the temperature rise from the light on the back of your hand.
Understanding leads to improved clinical success

Light energy matters!
“We don’t need to think more, we need to think differently.”
— Albert Einstein