Achieving Clinical Success with Photocured Resin Restorations

April 17, 2024

Richard Price BDS, DDS, MS, PhD

DALHOUSIE UNIVERSITY *Inspiring Minds*

1

5TH ANNUAL DCG DISTINGUISHED LECTURE SERIES ON EVIDENCE-BASED CLINICAL TREATMENT

Is Evidence-based Dentistry Possible

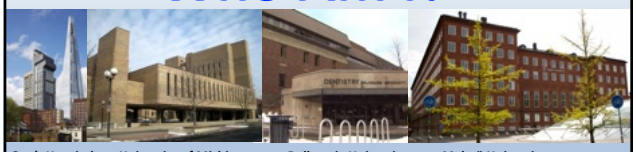
April 20, 2024

Richard Price BDS, DDS, MS, PhD

DALHOUSIE UNIVERSITY *Inspiring Minds*

2

Who Am I?

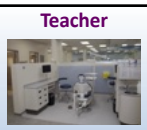


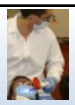
Guy's Hospital 1979 | University of Michigan 1984 | Dalhousie University 1988 | Malmö University 2001

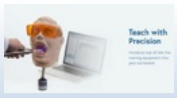
YouTube
PriceCuringLab

8

Teacher







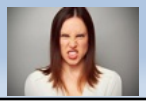
Prosthodontist

Researcher
h-index 55

https://scholar.google.com/citations?user=EBvKaOUAAAAJ&hl=en

9

Stop messing around!
TELL ME WHAT LIGHT TO BUY
I OWE
$300,000

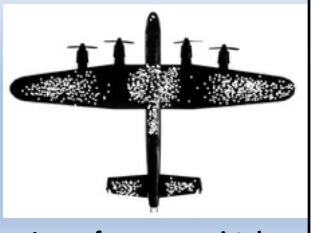


ADEA THE VOICE OF DENTAL EDUCATION

Average US dental school debt in the Class of 2023 $296,500

10

Black Box Thinking



Learn from your mistakes

12

The success rates for funding applications below 15% in 2018 (less than one in six successful applications).

Success rates under 20% means that the university wastes money writing & reviewing grant applications. AND

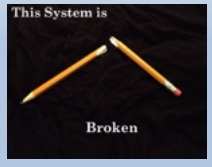
Current 15% funding level is only achieved by making drastic cuts to the budgets (often >25%).

https://can-acn.org/science-funding-in-canada-statistics/#:~:text=The%20success%20rates%20for%20funding,one%20in%20six%20successful%20applications)

13

Granting Agencies are Basically Useless To Clinicians

With an Overall 15 to 28% Success Rate and Even this $$ is at a REDUCED BUDGET



The university wastes money and resources writing & reviewing applications

14

The chance of a Clinical Dentist or Hygienist being successful in today's research grant environment is simply

too low to be sustainable

15

NOT ONLY ARE WE DROWNING IN LITERATURE THAT USUALLY DOES NOT TELL US WHAT TO USE ON OUR PATIENTS

17

WE ARE DROWNING IN ADMINISTRATOR INSPIRED FORMS TO COMPLETE

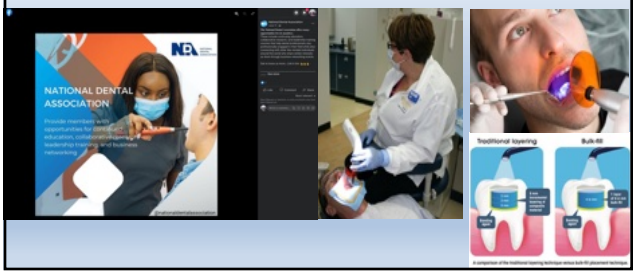
OOPS!

18

COMPANIES AND CE COURSES FOCUS ON MAKING IT LOOK GOOD

19

LIGHT CURING IS SO EASY



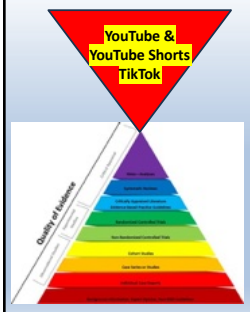
20

Listen Carefully to the Terms Used by the KOLs

21

EVIDENCE-BASED DENTISTRY

22



AS A KID, I USED TO WATCH THE WIZARD OF OZ AND WONDER HOW SOMEONE COULD TALK IF THEY DIDN'T HAVE A BRAIN. THEN I GOT SOCIAL MEDIA.

24

You Can Feel the Difference in the Composites you Cure With This Light

A conversation about Vista Apex's PinkWave Curing Light with Mike Miyasaki, DDS

25

JOURNALS THAT I READ ALMOST EVERY MONTH

- Dental Materials
- Journal of Dental Research
- Journal of Dentistry
- Operative Dentistry
- Journal of Prosthetic Dentistry
- Evidence Based Dentistry
- Cochrane Reviews
- Journal of Dental Education
- Journal of Adhesive Dentistry
- Journal of Clinical Oral Investigations
- JCDA
- JADA

28

OTHER SOURCES

- **DENTAL ADVISOR**
  https://www.dentaladvisor.com
- **CLINICIANS REPORT**
  https://www.cliniciansreport.org
- **DENTAL CLINICAL PEARLS** (FACEBOOK)
  https://www.facebook.com/groups/DentalClinicalPearls

29

Enhancing the Value of Dental Biomaterials Research: "Reducing the Noise"

R.B. Price[1] and J.L. Ferracane[2]

- For manufacturers and researchers, convene consensus development conferences to identify and disseminate the most appropriate and clinically relevant tests for evaluating new products and ideas.
- For in vivo studies, standardize evaluation criteria, separate survival and success rates, and address censored data, dropouts, and failure types.
- For in vitro studies, follow appropriate standards and guideline documents to identify the most important and clinically relevant properties and use the most appropriate test methodologies. Also, contribute to fundamental studies that offer improvements to these methods.
- When assessing journal articles, make value decisions about the work based on a complete reading with consideration of the validity of the methods and in relation to other publications.
- For mentors and key opinion leaders, teach and encourage new investigators to conduct high-quality, relevant, nonbiased, and scientifically sound studies.
- Whenever possible, researchers should submit their proposed study to a third party for review before commencing the study.

30

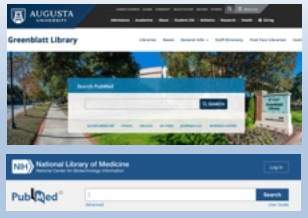
What to Look for in the Literature

- Approach the article critically, question assumptions, consider alternative interpretations, and assess the strengths and weaknesses of the research.
- Look for the research question or objective. Is the problem relevant?
- **Read what the authors did. Do you do that?**
- Are the findings clearly presented and supported by the data?
- Look for any biases or conflicts of interest
- **Do not just read the abstract.**
- **Trust quality journals with a high impact factor: JDR, JPD, JERD, DM, JADA, Operative Dentistry, BDJ, Int J Prosthodontics**

31

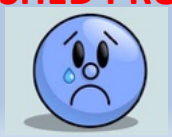
How to Find Information

- Greenblatt University Library
- PubMed
- **Chat GPT**
- **Colleagues**
- **CE Courses**
- Google Scholar



32

Lack of understanding that manufacturers are SELLING and dentists are USING UNFINISHED PRODUCTS



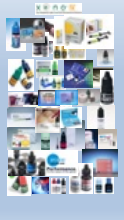
36

UNCURED, EVEN DANGEROUS AT THE BOTTOM

37

How Often Do You Hear?

OUR BOND STRENGTH IS BETTER THAN?



38

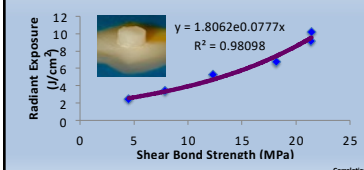
Most Research Articles on Resin Polymerization Overcure : WHY

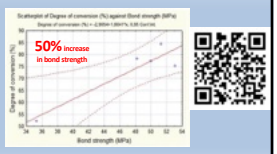
39

ZERO BOND STRENGTH

40

Good Bonding Requires Adequate Light Curing!



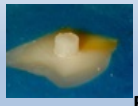


Xu X, Sandras DA, Burgess JO. Shear bond strength with increasing light-guide distance from dentin. J Esthet Restor Dent 2006;18(1):19-27

Correlation between degree of conversion, resin–dentin bond strength and nanoleakage of simplified etch-and-rinse adhesives. Hass et al. Dental Materials 29 (2013) 921–928

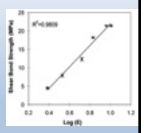
41

If You Light Cure Properly You Can EASILY Double Your Bond Strengths!

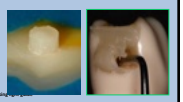


Improve Bond Strength

Linear correlation between Bond Strength and Log of Radiant Exposure

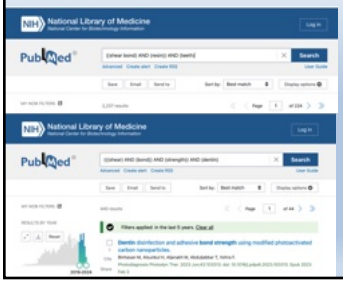


Exponential Relationship



43

Shear Bond, Resin and Teeth



2,237 articles

440 articles since 2019

44


Analysis of dental shear bond strength tests, shear or tensile?

BUT

The adhesive formulation that scores best commonly makes it rapidly to the market, after which the superior laboratory performance of the product is **hopefully** confirmed in independent randomized controlled clinical trials.

BUT, **calculation of shear bond strength is inappropriate for these test methods.** The results of this investigation **and others strongly suggest that dental adhesion researchers** should be measuring the stress that initiates debonding rather than average stress.

45


Investigating failure behavior and origins under supposed "shear bond" loading

Hassam Sultan, J. Robert Kelly*, Reza B. Kazemi

"Shear bond" testing does not appear to test the bonded interface.

Load/area stress calculations have no physical meaning.

46


Brazilian Dental Journal (2017) 28(1): 16-23
http://dx.doi.org/10.1590/0103-6440201700879

Influence of Different Dentin Substrate (Caries-Affected, Caries-Infected, Sound) on Long-Term μTBS

(1) Bonding with sound dentin showed μTBS values significantly higher compared to caries-affected and caries-infected dentin.

(2) 6 months and 1 year storage periods resulted in decreased bond strengths for all dentin conditions.

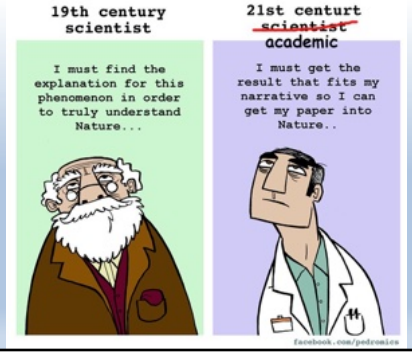
(3) Bonding to infected and affected dentin is not a suitable procedure compared to sound dentin.

47

"Shear bond" testing is only a screening tool that tells you if the adhesive works.

The test is flawed and should not be used as a test to discriminate between products.

48



49

50

LIGHT CURING AFFECTS DENTISTRY

Bonding

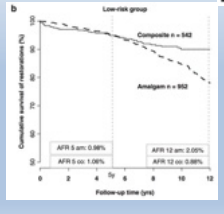
Curing

Overall Success

51

Opdam et al. 12 Year Study: 2010

- PhotoBond/SA Primer 93% of the restorations
- Clearfil PhotoPosterior (44%) and AP-X (32%)
- Differences between these two materials only emerge after more than 5 years.



Opdam et al: 12-year survival of composite vs. amalgam restorations. JDR 2010:1063

52

2016

Variations in survival time for amalgam and resin composite restorations: a population based cohort analysis

S. Birch[1], R. Price[2], P. Andreou[3], G. Jones[4] and A. Portolesi[5]

- Resin composite restorations performed no better than amalgams over the study period, but cost considerably more.
- Median survival times for resin composite and amalgam restorations respectively placed in 2009-10 **was 7.0 years**

Community Dental Health (2016) **33,** 1–5

53

2018

The ultimate guide to restoration longevity in England and Wales. Part 4: resin composite restorations: time to next intervention and to extraction of the restored tooth

Table 1 Survival of composite restorations, overall, with respect to time to re-intervention, compared with other restorations

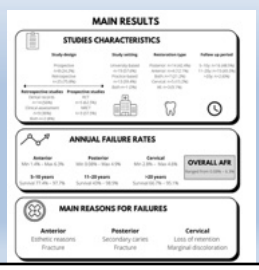
Type of treatment	Survival (%) at				
	1 year	5 years	10 years	15 years	n
Amalgam	91	66	51	41	7,292,564
Composite resin	**87**	**59**	**43**	**34**	**3,504,225**
Glass ionomer	84	53	37	28	1,592,566
Crown	93	77	63	53	1,202,005

BRITISH DENTAL JOURNAL, VOLUME 224 NO. 12. JUNE 22 2018

54

2023

Longevity of composite restorations is definitely not only about materials



33 studies

AFR Ranged: 0.8 to 6.3%

Differences between composites play a minor role in durability, assuming they are properly used

55

2023 DENTISTS MAKE THE BIGGEST DIFFERENCE, NOT THE MATERIALS

Longevity of composite restorations is definitely not only about materials

33 studies

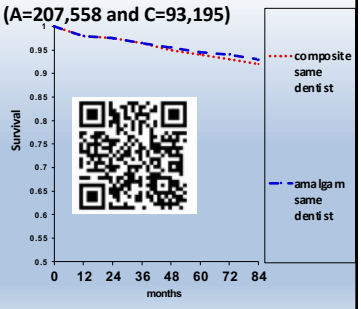
AFR Ranged: 0.8 to 6.3%

Differences between composites play a minor role in durability, assuming they are properly used

56

Two Surface Amalgam and Composite Survival in 300,753 patients (A=207,558 and C=93,195)

Changing dentists had the greatest effect on survival

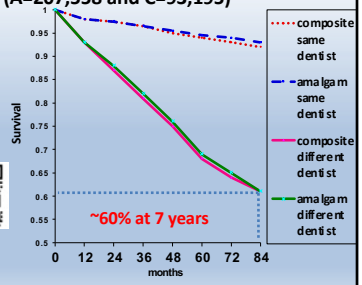


Data from Delta Dental Plan - Bogacki et al., Oper Dent 27:488-492, 2002

57

Two Surface Amalgam and Composite Survival in 300,753 patients (A=207,558 and C=93,195)

Changing dentists had the greatest effect on survival



Data from Delta Dental Plan - Bogacki et al., Oper Dent 27:488-492, 2002

58

Every study has shown that many lights deliver an inadequate light output and are poorly maintained

21 Papers

1. El-Mowafy O, El-Badrawy W, Lewis DW, et al. Efficacy of halogen photopolymerization units in private dental offices in Toronto. J Can Dent Assoc. 2005;71:587.
2. Barghi N, Fischer DE, Pham T. Revisiting the intensity output of curing lights in private dental offices. Compend Contin Educ Dent. 2007;28:380-4.
3. Hegde V, Jadhav S, Aher GB. A clinical survey of the output intensity of 200 light curing units in dental offices across Maharashtra. J Conserv Dent. 2009;12:105-8.
4. Al Shaafi M, Mawadah A, Al Qahtani M. Evaluation of light intensity output of CDH and LED curing devices in various governmental health institutions. OperDent. 2011;36:356-61.
5. Maghaireh GA, Alzraikat H, Taha NA. Assessing the irradiance delivered from light-curing units in private dental offices in Jordan. J Am Dent Assoc. 2013;144:922-7.
6. Santini A, Turner S. General dental practitioners' knowledge of polymerisation of resin-based composite restorations and light curing unit technology. *Br Dent J*. Sep 23 2011;211(6):E13. doi:10.1038/sj.bdj.2011.768
7. Koppenaal SE, Rukke HV, Kopperud HM, Bruzell EM. Light curing procedures - performance, knowledge level and safety awareness among dentists. *J Dent*. Mar 2017;58:67-73. doi:10.1016/j.jdent.2017.02.002
8. Al-Senan D, Ageel F, Aldosari A, Maktabi H. Knowledge and Attitude of Dental Clinicians towards Light-Curing Units: A Cross-Sectional Study. *Int J Dent*. 2021/06/15 2021;2021:5578274. doi:10.1155/2021/5578274
9. Ahtaie A, Hadis MA, Wilson V, et al. An Evaluation of the Efficacy ted Kingdom. *Oper Dent*. May 1 2021;46(3):271-282. doi:10.2341/20-092-LIT
10. Afshar MK, Eskandarizadeh A, Hasanabadi F, Torabi M. Evaluatior ontrol of the Dental Light-Curing Units in Kerman in 2017. *Health and Development Journal*. 2021;10(3):180-186. doi:10.22062/jhd
11. Frazier K, Bedran-Russo AK, Lawson NC, et al. Dental light-curing *Dent Assoc*. Jul 2020;151(7):544-545 e2. doi:10.1016/j.adaj.2020.03.001
12. Ernst CP, Price RB, Callaway A, et al. Visible Light Curing Devices - t;20(1):41-55. doi:10.3290/j.jad.a39881
13. Light Curing. *The National Dental Practice-Based Research Network*. 2021;(May)
14. Bonsor SJ, Palin WM. 'Let there be Light,' and there was Light, but was it Enough? A Review of Modern Dental Light Curing. *Dent Update*. 2021/09/02 2021;48(8):633-640. doi:10.12968/denu.2021.48.8.633
15. Georgiev GP. Factors associated with light curing units: a questionnaire survey. *Scripta Scientifica Medicinae Dentalis*. 12/31/ 2019;5(2):41-47.
16. Swathi T, Madhusudhana K, Suneelkumar C, Lavanya A. A clinical survey of the output intensity of light curing units in dental offices across Nellore urban area. Original Article. *SRM Journal of Research in Dental Sciences*. April 1, 2016 2016;7(2):64-68. doi:10.4103/0976-433x.182657
17. Morimoto S, Zanini RA, Meira JB, Agra CM, Calheiros FC, Nagase DY. Influence of physical assessment of different light-curing units on irradiance and composite microhardness top/bottom ratio. *Odontology*. Sep 2016;104(3):298-304. doi:10.1007/s10266-015-0229-y
18. Hao X, Luo M, Wu J, Zhu S. A survey of power density of light-curing units used in private dental offices in Changchun City, China. *Lasers Med Sci*. Feb 2015;30(2):493-7. doi:10.1007/s10103-013-1351-0
19. Alqaria T, Al Gady M, Khabeer A, Ali S. Types of polymerisation units and their intensity output in private dental clinics of twin cities in eastern province, KSA; a pilot study. *J Taibah Univ Med Sci*. Feb 2019;14(1):47-51. doi:10.1016/j.jtumed.2018.11.008
20. Algabbaa IM, Alsenani MS, Alcaif NS, Alcaif RA, Binalrimal SR. Light intensity output of visible light communication units and clinicians' knowledge and attitude among Riyadh private clinics. *J Conserv Dent*. Nov-Dec 2018;21(6):667-670. doi:10.4103/JCD.JCD_252_18

59

60

Dentist Time Vs. Real Time

61

How often do you hear?

Save Time, Buy this One Second Curing Light?

62

Irradiance (W/cm^2)

X

Time (s)

=

Radiant Exposure (J/cm^2)

64

Do the Math

A light emitting 1,200 mW/cm^2 for 20 s will deliver 24 J/cm^2 of energy

65

Do the Math

To deliver 24 J/cm^2 of energy in 1 s the light must emit 24,000 mW/cm^2

66

A Blinded Comparative Study of Four Commercially Available LEDs and a Laser Light Curing Device

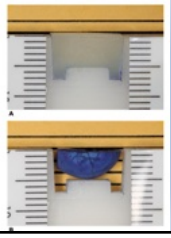
John C. Comisi[1] Cristiane Mauceski[2] Jonathan P. Beller[1] Kyle S. Dennis[1] Richard B. Price[2]

[1]Department of Oral Rehabilitation, James B. Edwards College of Dental Medicine, Medical University of South Carolina, Charleston, South Carolina, United States
[2]Department of Dental Clinical Sciences, Faculty of Dentistry, Dalhousie University, Halifax, Nova Scotia, Canada

Address for correspondence: John C. Comisi, DDS, Department of Oral Rehabilitation, Medical University of South Carolina, James B. Edwards College of Dental Medicine, Medical University of South Carolina, 173 Ashley Ave, BSB 548, MSC 507, Charleston, SC 29425, United States (e-mail: comisi@musc.edu).

Eur J Dent

The 1 second laser curing device did not photo-cure conventional composites as did the LED curing lights used for 10 seconds



67

The dental laser used for 1 s always produced a lower depth of cure than when the single- or multi-peak LCUs were used for 10 s

The radiant exposure in the Total and Blue wavelength ranges delivered to the RBC are key factors required to achieve the claimed depth of cure

68

Photopolymers exhibiting a large difference between glass transition and curing temperatures

J. G. Kloosterboer and G. F. C. M. Lijten
Philips Research Laboratories, PO Box 80000, 5600 JA Eindhoven, The Netherlands
(Received 29 March 1989; accepted 24 April 1989)

Inverse Square Relationship Between Irradiance and Time

4x Irradiance to Reduce Time by Half

$$\text{time} = \frac{\text{constant}}{\sqrt{\text{irradiance}}}$$

$$14\text{s} = \frac{345}{\sqrt{600}}$$

$$10\text{s} = \frac{345}{\sqrt{1200}}$$

$$7\text{s} = \frac{345}{\sqrt{2400}}$$

69

Rate of Photopolymerization $R_p = K [M] (I_o)^{1/2}$

Kloosterboer & Lijten, Polymer (1990), 31 P. 95-101

(double)

500 mW/cm² x 2 ⟶ 1,000 mW/cm²

For 40 s = For 20 s ?

Photopolymers exhibiting a large difference between glass transition and curing temperatures

J. G. Kloosterboer and G. F. C. M. Lijten
Philips Research Laboratories, PO Box 80.000, 5600 JA Eindhoven, The Netherlands
(Received 29 March 1989; accepted 24 April 1989)

70

Rate of Photopolymerization $R_p = K [M] (I_o)^{1/2}$

Kloosterboer & Lijten, Polymer (1990), 31 P. 95-101

(double)

500 mW/cm² x 2 ⟶ 1,000 mW/cm²

For 40 s = For 20 s

$\sqrt{2} = 1.44$ x

When intensity is doubled the R_p increases 1.44 times only

$\sqrt{16} = 4.0$ x

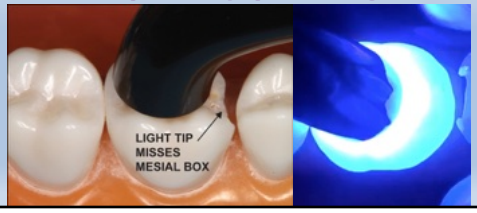
To reduce time from 20 to 5 seconds, need 16x the irradiance!

71

73

74

BULK FILLING
≠
BULK CURING



75

INCREMENTAL FILLING:
THE 'GOLD' STANDARD

Horizontal
Hilton & Ferracane, 1998

Buccal-Lingual
Lutz et al., 1986

Oblique
Pollack, 1987

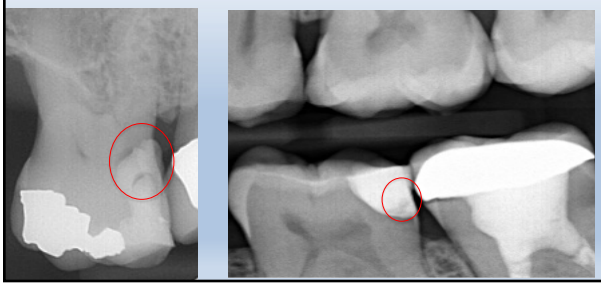
76

How Often do you Hear?

Bulk Fills are Bad

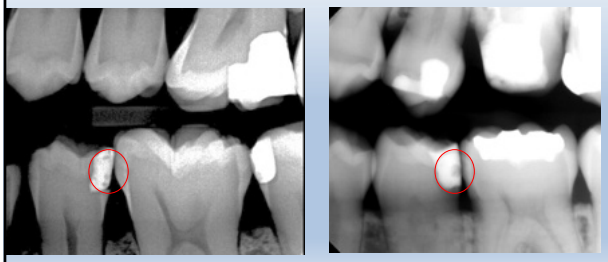
77

VOIDS



78

VOIDS



79

VOIDS

80

Black Box Thinking

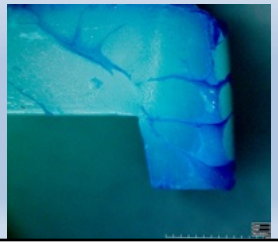
81

Air entrapment between increments can occur when the incremental technique is used, causing sensitivity and degradation of the resin material

Sajnani A, Hegde M (2016) Leaching of monomers from bulk-fill composites: an in vitro study. J Conserv Dent 19:482–486.
Alrahlah A, Silikas N, Watts DC (2014) Post-cure depth of cure of bulk fill dental resin-composites. Dent Mater 30:149–154.
El-Safty S, Akhtar R, Silikas N, Watts DC (2012) Nanomechanical properties of dental resin-composites. Dent Mater 28:1292–1300.

82

WHAT ABOUT THE SIDES AND BOTTOM THAT NOBODY SEES?




83

Voids and Porosities in Class I Micropreparations Filled with Various Resin Composites

NJM Opdam • JJM Roeters • T de Boer
D Peschier • E Bronkhorst

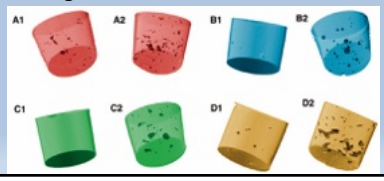
Narrow occlusal preparations are difficult to restore completely free of voids. Packable composites had poor results even in combination with an uncured flowable composite.

84

Effect of Sonic Resin Composite Delivery on Void Formation Assessed by Micro-computed Tomography

R Hirata • RR Pacheco • E Caceres • MN Janal • MF Romero
M Giannini • PG Coelho • FA Rueggeberg

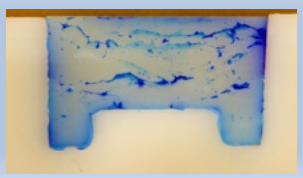
Sonic delivery may lead to a higher incorporation of air within the restoration and higher void formation.



85

How Are You Filling the Cavity?

YouTube VIDEOS:Filling



86

87

Original Research
Dentistry

Clinical time and postoperative sensitivity after use of bulk-fill (syringe and capsule) vs. incremental filling composites: a randomized clinical trial

Chana TARDEM[a]
Elias Gomes ALBUQUERQUE[a]
Leticia de Souza LOPES[a]
Stella Soares MARINS[a]
Fernanda Signorelli CALAZANS[a]
Luiz Augusto POUBEL[a]
Roberto BARCELLOS[a]
Marcos de Oliveira BARCELEIRO[a]

Incremental filling takes more than twice as long as bulk filling using capsules

	Mean Time (SD) seconds/mm³	Minimum–Maximum Time (s)
Incremental	28.42 (27.92)	2.04–117.50
Bulk Syringe	18.70 (20.43)	1.67–102.50
Bulk Capsule	12.32 (8.13)	2.18–44.75

88

2023

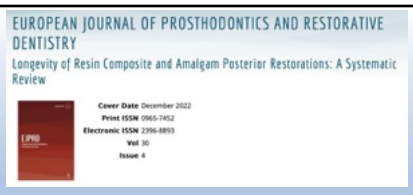

Clinical evaluation of bulk-fill and universal nanocomposites in class II cavities: Five-year results of a randomized clinical split-mouth trial

60 patients 120 class II restorations
Filtek Bulk Fill Posterior Restorative Filtek Supreme XTE Universal Restorative

Overall survival of restorations was 92% in both groups at 5 years

Both materials showed acceptable clinical performance

89

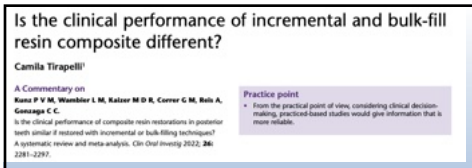

EUROPEAN JOURNAL OF PROSTHODONTICS AND RESTORATIVE DENTISTRY

Longevity of Resin Composite and Amalgam Posterior Restorations: A Systematic Review

Cover Date December 2022
Print ISSN 0965-7452
Electronic ISSN 2396-8893
Vol 30
Issue 4

Regardless of the restorative material, the successful results over more than 5 years are due much more to the correct application of the technique, the operator's skill/knowledge and factors related to the patient, such as the type of tooth, number of sufaces involved in the restoration and oral hygiene.

90


Is the clinical performance of incremental and bulk-fill resin composite different?

Camila Tirapelli[1]

A Commentary on
Kunz P V M, Wambier L M, Kaizer M D R, Correr G M, Reis A, Gonzaga C C.
Is the clinical performance of composite resin restorations in posterior teeth similar if restored with incremental or bulk-filling techniques? A systematic review and meta-analysis. *Clin Oral Investig* 2022; **26:** 2281-2297.

Practice point
- From the practical point of view, considering clinical decision-making, practiced-based studies would give information that is more reliable.

A systematic review and meta-analysis with moderated quality of evidence bulk fill and incremental techniques showed similar clinical performance on posterior resin composite restorations.

91


EBD

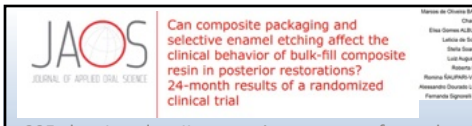
ARTICLE OPEN

The clinical performance of bulk-fill versus the incremental layered application of direct resin composite restorations: a systematic review

Arpita Sengupta[1], Olga Naka[1,2✉], Shamir B. Mehta[1] and Subir Banerji[2]

- **Out of the 1445 records two studies had an overall low-risk of bias, fourteen studies raised some concerns, and two studies exhibited high-risk.**
- **CONCLUSION: Bulk-filled resin composite restorations had clinical outcomes similar to those of incrementally layered resin composite restorations within a review interval of 6 months to 10 years.**

92


JAOS JOURNAL OF APPLIED ORAL SCIENCE

Can composite packaging and selective enamel etching affect the clinical behavior of bulk-fill composite resin in posterior restorations? 24-month results of a randomized clinical trial

295 class I or class II restorations were performed on 70 patients

Filtek Bulk-fill Posterior Restorative in syringes, Filtek One Bulk-fill in capsules, or Filtek Supreme Ultra in syringes

At 24 months, no differences between survival rates

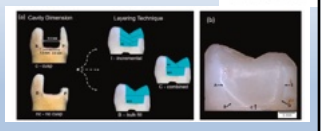
Composites in capsules showed better marginal adaptation after a 24-month recall than composites in syringes

Shorter clinical time required to restore them compared to bulk-fill in syringes, but time not stated

93


Dental Materials

- **The effect of the layering technique on the success of restorations depends on the cavity extension.**
- **The combined technique favors the adaptation and the longevity of extensively damaged teeth, while the bulk fill technique produces restorations with more predictable fatigue behavior.**
- **Restorations produced with the bulk fill technique had similar performance to the conventional incremental technique regarding fatigue survival and success, and marginal adaptation.**
- **A shorter time is required to produce the restoration with the bulk fill technique.**



So WHY LAYER?

94

Volumetric polymerization shrinkage and its comparison to internal adaptation in bulk fill and conventional composites: A μCT and OCT *in vitro* analysis

Camila S. Sampaio[a,b,*], Jessica Fernández Arias[b], Pablo J. Atria[a,b], Eduardo Cáceres[b,c], Carolina Pardo Díaz[c,d], Anderson Z. Freitas[e], Ronaldo Hirata[b]

Voids were observed in most of the RBC fillings

Micro CT and the OCT detected gaps in the pulpal floor of Class I restorations

Flowable bulk-fill resin composite (FBF) had a similar volumetric polymerization shrinkage to Z100

Bulk fill resin composites had less volumetric polymerization shrinkage compared to Z100

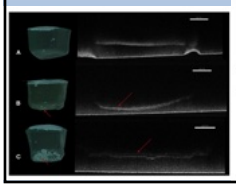


Table 1 – Means (% ± SE) of volumetric shrinkage determined for each resin composite material, observed through μCT.

	Volumetric shrinkage (%)
G1 – Filtek Z100 (Z100)	3.96 (0.30) A
G2 – Tetric EvoCeram Bulk fill (TEC)	2.31 (0.14) B
G3 – Tetric EvoFlow Bulk fill (TEF)	2.75 (0.32) AB
G4 – Filtek Bulk fill (FBU)	2.40 (0.28) B
G5 – Filtek Bulk fill Flowable (FBF)	3.50 (0.37) AB

95

The influence of different placement techniques on the clinical success of bulk-fill resin composites placed in Class II cavities: a 4-year randomized controlled clinical study

Nazire Nurdan Çakır Kılınç[1] · Sezer Demirbuğa[2]

A double-blind and split-mouth randomized controlled clinical trial was to evaluate the clinical success of the placement technique (bulk-filling and incremental techniques)

The 4-year clinical success of X-trafil and FiltekBulkFill composites is not dependent on the placement technique used.

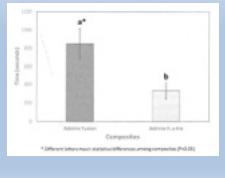
96

Research Article

Bulk-fill versus layering pure ormocer posterior restorations: A randomized split-mouth clinical trial

Carlos Rocha Gomes Torres, DDS, PhD, Ana Luiza Barbosa Jurema, DDS, MS, Mauricio Yugo de Souza, DDS, MS, Rebeca Di Nicolò, DDS, MS, PhD & Alessandra Bühler Borges, DDS, MS, PhD

The time necessary to perform the insertion of the restorative material was 2.5 times faster with the bulk application.



30 subjects

After 24 months of intraoral service, no difference between bulk fill and incremental fill composites.

The bulk-fill material (Admira Fusion x-tra) required significantly less chair time to apply than the layering one (Admira Fusion).

97

biomedicines MDPI

Article

Microleakage of Class II Bulk-Fill Resin Composite Restorations Cured with Light-Emitting Diode versus Quartz Tungsten-Halogen Light: An In Vitro Study in Human Teeth

Jenny López-Torres [1], Karen Hernández-Cuba [2], Luis Cervantes-Ganoza [3,*], Marysela Ladera-Castañeda [2], Reynaldo Martínez-Campos [4], Fredy Solís-Dante [5], Gissela Briceño-Vergel [1] and César Cayo-Rojas [1,*]

- Class II restorations with bulk-fill resin composite in IV-A and IV-B shades
- Light-cured with QTH (Litex 680A Dentamerica®); B, LED (Bluephase N® 3rd generation); and C, LED (Valo® 3rd generation).
- The third generation LED lamp and QTH showed no significant differences in microleakage when compared in both occlusal and cervical areas.
- More microleakage was found at the cervical level when a darker shade of resin composite was used and light-cured with the QTH unit.
- **Insufficient energy results in a poor result**

98

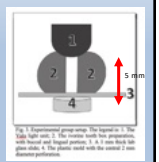
Effects of radiant exposure and distance on resin-based composite polymerization

Alyssa Teixeira Obeid, DDS, MS, Davé Darko Kojic, DMD, MS, PhD, Chris Felix, BSc, Marilia Mattar de Amoêdo Campos Velo, DDS, MS, PhD, Adilson Yoshio Furuse, DDS, MS, PhD & Juliana Fraga Soares Bombonatti, DDS, MS, PhD

Filtek Z250XT, Filtek One Bulk Fill, Filtek Bulk Fill Flow

1 mm distance (control-group) or through a 3 mm buccolingual extension and 2 mm mesial extension slot preparation in an ivorine tooth at a 5 mm distance

In the experimental group, where light-polymerization was conducted through the Class 2 slot cavity, at 5 mm distance, **the mean RH ratios of tested RBCs were significantly below the 0.80 ratios.**



Double the manufacturers' recommended exposure for the initial RBC increment in deep Class 2 interproximal slots.

99

How Often do you Hear?

Heated Composites are Bad

100

HEATED COMPOSITES

101

Heating and preheating of dental restorative materials—a systematic review

Larissa Coelho Pires Lopes[1] · Raquel Sano Suga Terada[1] · Fernanada Midori Tsuzuki[2] · Marcelo Giannini[2] · Ronaldo Hirata[3]

- 74 articles were selected.
- Preheating of composite resins reduces viscosity, facilitates adaptation to cavity preparation walls
- Preheating of dental restorative materials is a simple, safe, and successful technique.
- Care is STILL necessary to avoid bubbles and formation of gaps, which compromises the best restoration performance.

102

Heating and preheating of dental restorative materials—a systematic review

Larissa Coelho Pires Lopes[1] · Raquel Sano Suga Terada[1] · Fernanada Midori Tsuzuki[2] · Marcelo Giannini[2] · Ronaldo Hirata[3]

- 74 articles were selected.
- Preheating of composite resins reduces viscosity, facilitates adaptation to cavity preparation walls
- Preheating of dental restorative materials is a simple, safe, and successful technique.
- Care is STILL necessary to avoid bubbles and formation of gaps, which compromises the best restoration performance.

103

RESEARCH

Various ways of pre-heating a bulk-fill thermoviscous composite in restoration in non-carious cervical lesions: 12-month randomized clinical trial

- 120 restorations Caps Warmer (CD) or VisCalor Caps dispenser/warmer
- For the CD group, heating was carried at 68 °C . For the VD group, pre-heating was performed at 68 °C using a heating gun for 30 s. After that, pre-heated bulk-fill composites were directly inserted in the NCCLs. The total working time was recorded.
- The restorations evaluated after 6 and 12 months according to FDI criteria.
- Restoration time was shorter for VD: 36.5 min (± 2.5) for CD and 14.3 min (± 2.3) for VD
- The retention rates were 96.7% for CD and 98.3% for VD.
- The 2 heating ways did not influence the 12 month clinical performance

104

Effect of Repeated Preheating Cycles on Flexural Strength of Resin Composites

- Enamel Plus HFO (Micerium) (HFO), Enamel Plus HRi (Micerium) (HRi), Opallis + (FGM) (OPA)
- Preheating to a temperature of 45°C
- For all three composites, flexural strengths were not affected after 20 preheating cycles in comparison with the control groups (No preheating), but were, significantly decreased after 40 prewarming cycles

105

Clinical Research

36-Month Randomized Clinical Trial Evaluation of Preheated and Room Temperature Resin Composite

- 35 patients were selected. Every patient received one pair of class I nanofilled resin composite (RC, Filtek Z350 XT) posterior restorations (n=70)
- After 36 months, preheated nanofilled RCs showed an acceptable clinical performance similar to that of the nonheated ones in class I restorations, but with better resistance to marginal staining.
- Considering that postoperative sensitivity was reduced over time, its use in routine care can be considered a good practice.

106

Influence of preheating on mechanical and surface properties of nanofilled resin composites

Ali-Atef Elkaffass [1], Radwa-Ibrahim Eltoukhy [2], Salwa-Abd-Elraof Elnegoly [3], Salah-Hassab Mahmoud [4]

Filtek Z350 XT 24ºC and 68ºC for 5 min to reach the temperature of the warming device.
Heating procedure did not negatively affect microhardness, fracture toughness and surface roughness of nanofilled resin composites

107

Composite pre-heating: Effects on marginal adaptation, degree of conversion and mechanical properties

Nívea Regina Fróes-Salgado[a], Luciana Maria Silva[a], Yoshio Kawano[b], Carlos Francci[a], Alessandra Reis[c,*], Alessandro D. Loguercio[c]

The pre-heated composite showed better margin adaptation than the room-temperature composite.
More gaps were observed in the room-temperature groups, mainly in the axial wall (p<0.05).
Composite pre-heating did not affect the DC, FS and PCL (p>0.05).
SIGNIFICANCE: Pre-heating the composite prior to light polymerization provides enhanced composite adaptation to cavity walls.

108

Dental Materials Journal 2015; 34(5): 703–706

Effect of preheating on the viscoelastic properties of dental composite under different deformation conditions

Kyung Hyun AHN[1], Sanghyuk LIM[2], Kee Yeon KUM[2] and Seok Woo CHANG[2]

Preheating of Filtek Z350 might be helpful in clinical practice both to increase the slumping resistance when minimal manipulation is used (e.g., during the build-up of a missing cusp tip) and to increase flowability when manipulation entailing high shear strain is applied (e.g., when uncured composite resin is spread on a dentin surface)

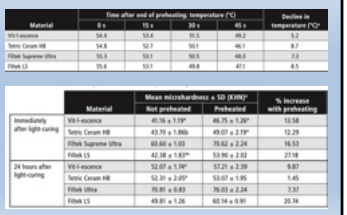
109

Effect of Preheating on Microhardness and Viscosity of 4 Resin Composites

Karen V. Ayub, DDS, MSc; Gildo C. Santos, Jr., DDS, MSc, PhD; Amin S. Rizkalla, BSc, MEng, PhD; Richard Bohay, DMD, MSc; Luis Fernando Pegoraro, DDS, MSc, PhD; José H. Rubo, DDS, MSc, PhD; M. Jacinta M.C. Santos, DDS, MSc, PhD

Vit-l-escence, Tetric Ceram HB, Filtek Supreme Ultra, Filtek LS
Preheating to 68°C increased the microhardness and decreased the viscosity.
resin composite material was inserted into the mould within 45 seconds after removal from the heating device.
Filtek Supreme Ultra had the highest mean microhardness, and Vit-l-escence resin composite had the lowest viscosity.
The effects of preheating resin composites allows easier placement of restorations and greater hardness

110



Material	Time after end of preheating: temperature (°C) 0 s	15 s	30 s	45 s	Decline in temperature (°C)*
Vit-l-escence	54.4	53.4	50.5	49.2	5.2
Tetric Ceram HB	54.8	52.7	50.1	46.1	8.7
Filtek Supreme Ultra	55.3	53.1	50.5	48.0	7.3
Filtek LS	55.6	53.1	49.8	47.1	8.5

	Material	Mean microhardness ± SD (KHN)* Not preheated	Preheated	% increase with preheating
Immediately after light-curing	Vit-l-escence	41.16 ± 1.19*	46.75 ± 1.26*	13.58
	Tetric Ceram HB	43.70 ± 1.86b	49.07 ± 2.19*	12.29
	Filtek Supreme Ultra	60.60 ± 1.03	70.62 ± 2.24	16.53
	Filtek LS	42.38 ± 1.83**	53.90 ± 2.02	27.18
24 hours after light-curing	Vit-l-escence	52.07 ± 1.36*	57.21 ± 2.39	9.87
	Tetric Ceram HB	52.31 ± 2.05*	53.07 ± 1.95	1.45
	Filtek Ultra	70.81 ± 0.83	76.03 ± 2.24	7.37
	Filtek LS	49.81 ± 1.26	60.14 ± 0.91	20.74

Prewarming effect on adaptation, porosities, and strength of a composite resin

Restorations made with prewarmed composite had significantly fewer large voids and better adaptation to cavity walls and between layers (P < 0.05).
Strength of prewarmed composite was higher than room temperature composite, and was significantly higher in monolithic specimens (P < 0.05).
It was concluded that prewarming conventional composite can improve its handling, making it handle more like a flowable composite without jeopardizing physical properties.

111

Operative Dentistry, 2021, xx-x, 000-000

Effects of Preheating and Sonic Delivery Techniques on the Internal Adaptation of Bulk-fill Resin Composites

G Demirel • AI Orhan • O Irmak • F Aydın • A Büyüksungur • B Bilecenoğlu • K Orhan

- **Preheating produced fewer gaps compared to conventional placement (p<0.05).**
- **For conventional placement, the lowest gap percentage was observed with the incremental resin composite (CMP, p<0.05).**
- **The lowest gap percentages were for preheated VCB followed by sonically inserted SF2 (p<0.05).**
- **The best internal adaptation was observed in sonically inserted SF2 and preheated VCB**

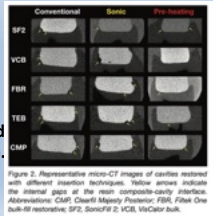


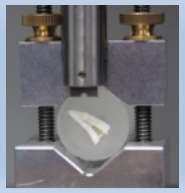
Figure 2. Representative micro-CT images of cavities restored with different insertion techniques. Yellow arrows indicate the internal gaps at the resin composite-cavity interface. Abbreviations: CMP, Clearfil Majesty Posterior; FBR, Filtek One bulk-fill restorative; SF2, SonicFill 2; VCB, VisCalor bulk.

112

Effect of composite warming on shear bond strength

Thomas F. McDaniel, DMD, FAGD ▪ Thomas W. Sigrist, DDS ▪ Gary M. Johnson, DDS

14 Empress Direct Cavifil D1 shade composite specimens prewarmed in an incubator to 54°C and 14 used at room temperature 22°C. Bonded to bovine enamel and dentin and photopolymerized with a Valo for 20s.
After storage in water for 24 hours, all specimens were subjected to shear bond testing.
There was no difference between the shear bond strengths of the prewarmed and room temperature composite resin specimens.
The warm composite resin seemed easier to place in the Ultradent jig and was less adherent to the placement instrument.



113

Available online at www.sciencedirect.com
ScienceDirect
journal homepage: www.intl.elsevierhealth.com/journals/dema

Pre-heating time and exposure duration: Effects on post-irradiation properties of a thermo-viscous resin-composite

Jiawei Yang[a], Nikolaos Silikas[a,*], David C. Watts[a,b,*]

Pre-heating did not increase the DC(24h), relative to no pre-heating (p>0.05).
Increasing irradiation time from 20 to 40s did not affect DC, RP(max) or PS, but increased VHN(top).
Composite pre-heating had no adverse effect through any premature polymerization.

Table 3 – Maximum rates of polymerization (RP_{max}, %/s) of Viscalor (no heat, T3-30s and T3-3min) with different exposure durations.

Materials	RP_{max}	
	20 s	40 s
Viscalor (no heat)	1.85 ^{aA} (0.42)	1.79^{aA} (0.32)
Viscalor (T3-30s)	1.95^{A} (0.11)	1.76^{AB} (0.49)
Viscalor(T3-3min)	1.96^{aA} (0.12)	1.78^{aB} (0.35)

For each exposure duration, the same lower case superscript letters indicate homogeneous subsets among the materials. For each material, the same CAPITAL superscript letters indicate homogeneous subsets among different conditions.

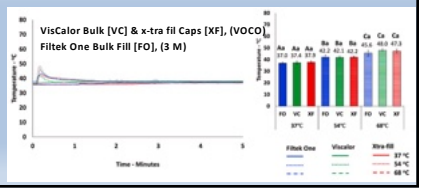
114

Journal of the Mechanical Behavior of Biomedical Materials

Effect of pre-heating methods and devices on the mechanical properties, post-gel shrinkage, and shrinkage stress of bulk-fill materials

Maria Tereza Hordones Ribeiro[1], Gabriel Felipe de Bragança[1], Laís Rani Sales Oliveira[1], Stella Sueli Lourenço Braga[1], Helena Leticia Quirino de Oliveira[1], Richard Bengt Price[2], Carlos José Soares[1,*]

- The temperature fell rapidly after the RBC was inserted into the cavity.
- Pre-heating the RBCs did not affect the mechanical properties.
- FO had the lowest E, DC, and KH values, VC had intermediate values, and XF achieved the highest values.
- The DTS and CS values were not affected by the various pre-heating methods, the temperature, or RBC.
- At 10 min after light activation, VC pre-heated to 65 degrees C produced

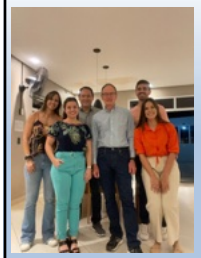


115

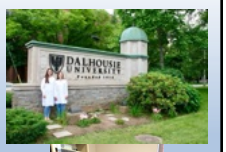
If You Want To Improve Your Bond Strengths?
LIGHT CURE PROPERLY
Check out ALL the Bonding Research Papers

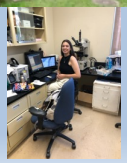
116

Thank You



Acknowledgements
Prof. Marcelo Giannini
Prof Cesar Arrais
Prof. Carlos Soares
Prof. Jack Ferracane
Prof. Howard Strassler
Prof. Daniel Labrie
Prof. Fred Rueggeberg
Dr. Cristiane Maucoski
Dr. Thorsten Bock (Ivoclar)
Dr. Benjamin Gebhard (Ivoclar)
Dr. Joe Oxman (3M)
Dr. Frank Pfefferkorn (Dentsply Sirona)
Neil Jessop (Ultradent)





DALHOUSIE UNIVERSITY

118

5TH ANNUAL DCG DISTINGUISHED LECTURE SERIES ON EVIDENCE-BASED CLINICAL TREATMENT

A Deep Dive into Dental Curing Lights: What's REALLY important

Achieving Clinical Success with Photocured Resin Restorations

Richard Price BDS, DDS, MS, PhD

April 20, 2024

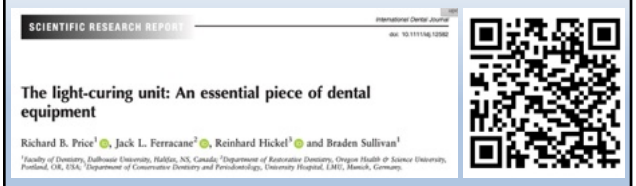
DALHOUSIE UNIVERSITY
Inspiring Minds

119

WELCOME TO
The Dark Art of Curing Lights

120

CURING LIGHTS

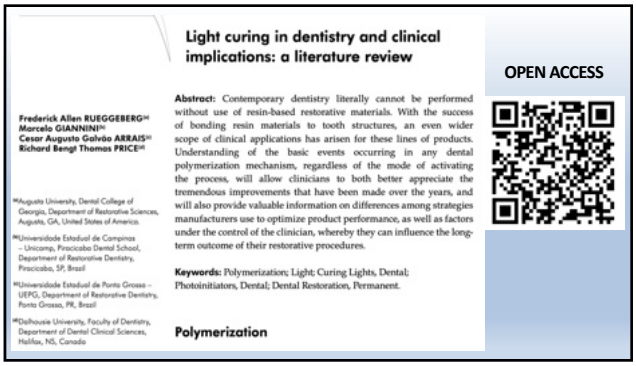


SCIENTIFIC RESEARCH REPORT

The light-curing unit: An essential piece of dental equipment

Richard B. Price[1], Jack L. Ferracane[2], Reinhard Hickel[3] and Braden Sullivan[1]

121



Light curing in dentistry and clinical implications: a literature review

OPEN ACCESS

Frederick Allen RUEGGEBERG[I]
Marcelo GIANNINI[II]
Cesar Augusto Galvão ARRAIS[III]
Richard Bengt Thomas PRICE[IV]

[I]Augusta University, Dental College of Georgia, Department of Restorative Sciences, Augusta, GA, United States of America.
[II]Universidade Estadual de Campinas – Unicamp, Piracicaba Dental School, Department of Restorative Dentistry, Piracicaba, SP, Brazil
[III]Universidade Estadual de Ponta Grossa – UEPG, Department of Restorative Dentistry, Ponta Grossa, PR, Brazil
[IV]Dalhousie University, Faculty of Dentistry, Department of Dental Clinical Sciences, Halifax, NS, Canada

Abstract: Contemporary dentistry literally cannot be performed without use of resin-based restorative materials. With the success of bonding resin materials to tooth structures, an even wider scope of clinical applications has arisen for these lines of products. Understanding of the basic events occurring in any dental polymerization mechanism, regardless of the mode of activating the process, will allow clinicians to both better appreciate the tremendous improvements that have been made over the years, and will also provide valuable information on differences among strategies manufacturers use to optimize product performance, as well as factors under the control of the clinician, whereby they can influence the long-term outcome of their restorative procedures.

Keywords: Polymerization; Light; Curing Lights, Dental; Photoinitiators, Dental; Dental Restoration, Permanent.

Polymerization

122

123

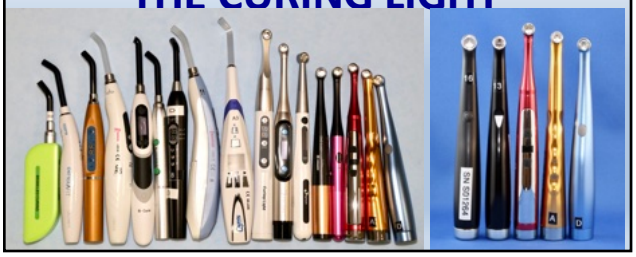
MY GOAL IS TO PREVENT THIS

My client claims:

- The curing light was not licensed for use in …….
- Your curing light was not working properly
- Your curing light was improperly used
- The curing light burnt the gums, teeth, eyes, etc
- The restorations you placed:
  - Leached dangerous chemicals into the body
  - Broke
  - Fell out
  - Caused harm

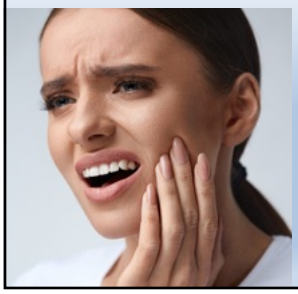
124

YOUR SUCCESS DEPENDS ON THE CURING LIGHT



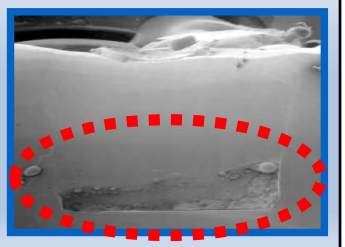
125

ANGELA




126

WHY ARE MY FILLINGS FAILING?

127

QUESTIONS FOR YOU ABOUT YOUR CURING LIGHT


128

1

Curing lights are medical devices

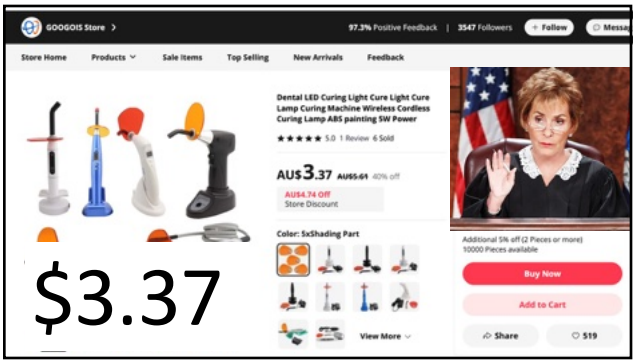
Is YOUR light approved for use on patients?


129

1 **Dental Curing Lights**

In the USA, Curing Lights are Class II Medical Devices.


130



131

Dentists who import products from Amazon, Alibaba etc, are responsible for the licensing process

If unsure if a product is licensed, contact Medsafe:https://www.medsafe.govt.nz/other/contact.asp

132

AVOID GREY MARKET PRODUCTS

Do You Know if You Are Using Gray Market or Counterfeit Products? *(Continued from page 1)*

What is a gray market or counterfeit product?

These products are usually brand-name products that you recognize, purchased at low cost by U.S. dental supply companies usually from out of the U.S. and imported into the U.S. for sale. Estimates are that about 15% of current products sold in the U.S. are in these categories. These products range from excessive purchases of U.S. products by distributors in other countries that were not sold there, to early generation products no longer registered in the U.S., to outright counterfeit products of unknown composition.

How do you identify gray market or counterfeit products?

- **Low cost:** This is the best clue! Most legitimate dental distributors in the U.S. agree that products selling for more than 15% under the normal retail price are likely to be gray market or counterfeit.
- **Packaging that is suspicious:** Poor printing on the package, company name not the currently used name of the company, bar code blocked out, statement clearly stating the product is for use in a country other than the U.S., language on the product not English, and other suspicious characteristics.
- **Expired date:** Check the expiration date. Has it passed? Is it smeared or blotted out?

Avoiding gray or counterfeit products:

- **Use authorized distributors.** The major, well-known distributors in the U.S. can be trusted to avoid such products. Also, you may call the manufacturer in question and see if the distributor selling the product is authorized to do so.
- **Avoid "too good to be true" prices.** Legitimate products can't be sold for extremely low prices.

CR CONCLUSIONS: The U.S. FDA and your trusted local distributors are trying to ensure that you treat your patients with legitimate products. We suggest that you avoid these relatively easily identified gray or black market products.

133

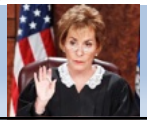
Join 3M to Protect Patient Safety and Dental Practices against Gray Market & Counterfeit Products

A Serious Threat to Patient Safety

Gray market is a serious threat to patient safety

Gray market has grown as the internet and online purchasing venues have provided easy opportunities for unauthorized products to enter the marketplace, with little scrutiny.

These products can be difficult to distinguish from authentic ones and are tempting to buy because they're often priced lower than products sold through a secure supply chain. But there's a huge potential downside when using them. Every gray market product raises the risk of product failure due to improper storage, shipping or phony expiration dates – not to mention the risk of using an inferior quality, counterfeit product.



134

2 Warranty

Who do I contact in case of a problem?

$15.99

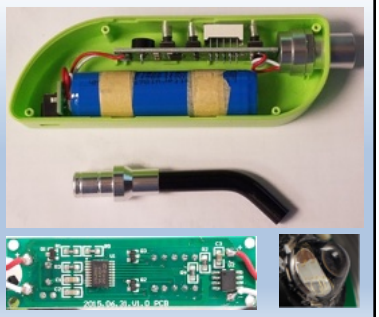
91 sold

1500 mW?

https://www.ebay.com/itm/232076352223

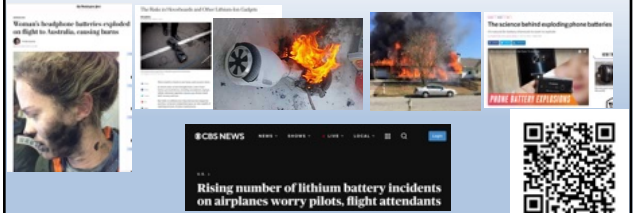
135

2 Battery Soldered to the Board



136

Has the Battery/Charger Been Approved for Use?



137

138

Problem: Batteries

- Sensitive to how they are used (NiMH)
- Take a long time to recharge (60-180 min)
- Lose capacity quickly (DoD)
- Expensive to replace (up to $320)
- When a curing light doesn't work DENTISTRY CAN'T HAPPEN!

139

140

BATTERIES

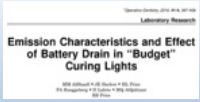
Elipar DeepCure-S Li-Ion Battery Ea (5843157) 1 @ $435.00

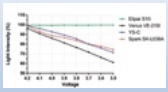
Demi Plus Battery Pack Ea (1231435) Kerr (921918-1) 1 @ $346.49

Bluephase Style Battery Ea (9450403) Ivoclar Vivadent (637692) 1 @ $239.59

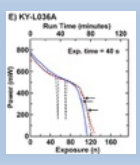
141

BUDGET LIGHTS





Effects of Declining Battery Voltage on Light Intensity and Power Consumption of Light-Curing Units



Battery Charge Affects the Stability of Light Intensity from Light-emitting Diode Light-curing Units

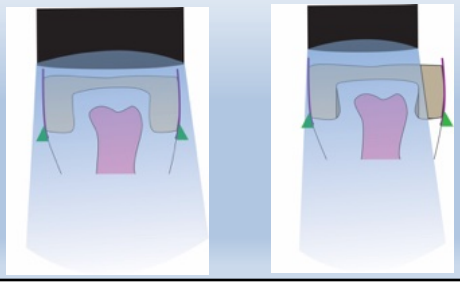
J Clin Orthod. 2017;51(7):411-418 Oper Dent. 2016;41(4):397-408

142

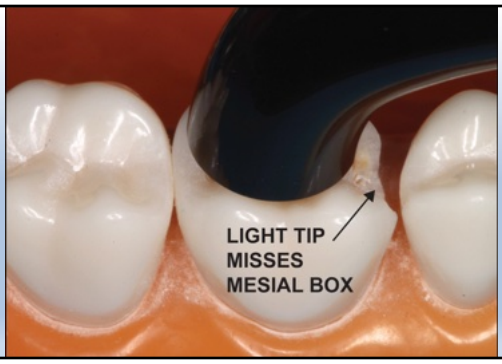
WATCH OUT FOR COPIES

143

TIP SIZE is REALLY Important

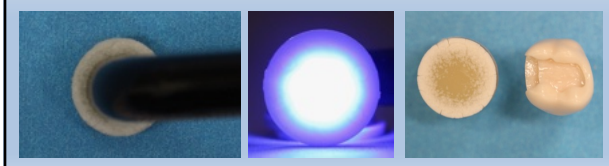


144

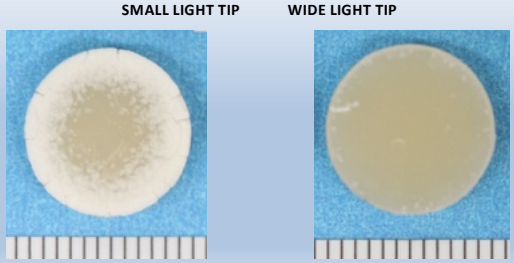


145

WHAT IS BEYOND THE TIP MAY NOT CURE AS WELL: SOLVENT RESISTANCE

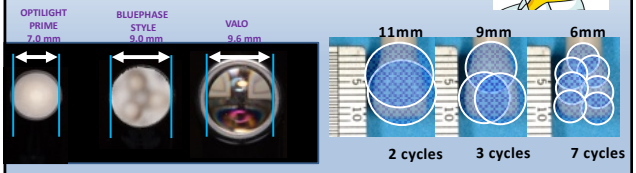


146



147

LIGHT TIP DIAMETER

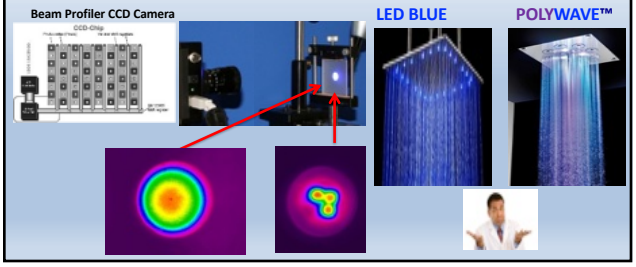


If Tip Does Not Cover Resin, It Will Not Cure (Repeated Cures Required)

148

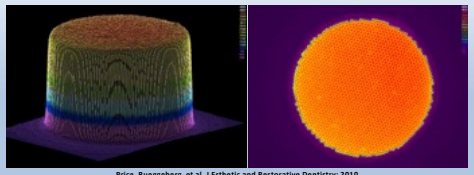
What is a Beam Profiler?

Takes a Digital Picture of Light Distribution



149

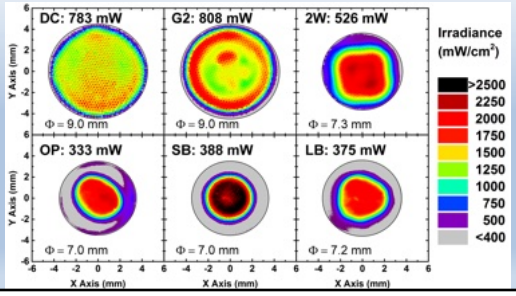
Ideal Beam Uniformity



Price, Rueggeberg et al. J Esthetic and Restorative Dentistry: 2010

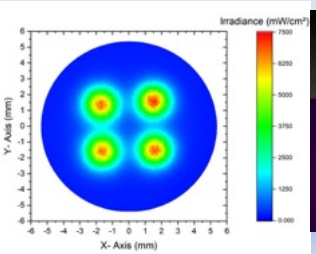
150

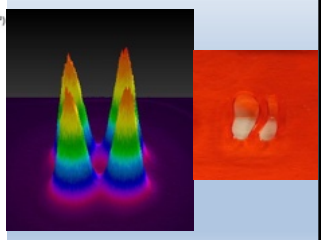
TIP DIAMETER & BEAM PROFILE



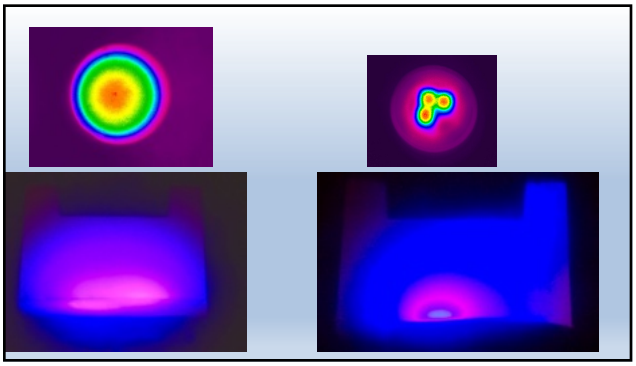
151

Plastic Melts Under the 'Hot Spots'





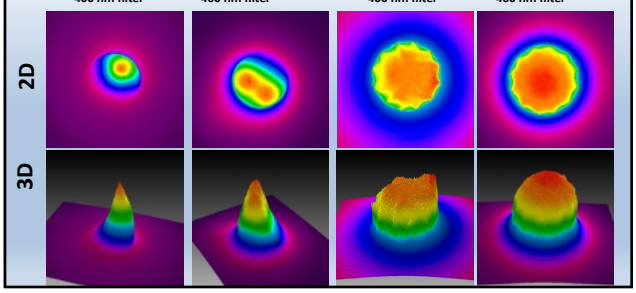
152



153

'A' Curing Light

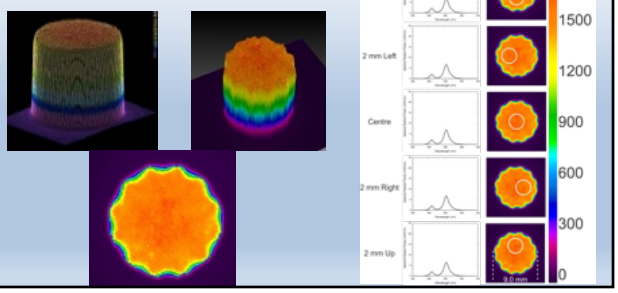
Bluephase G4



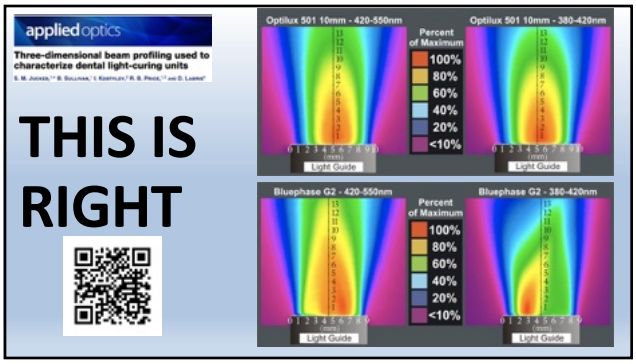
154

BEAM UNIFORMITY

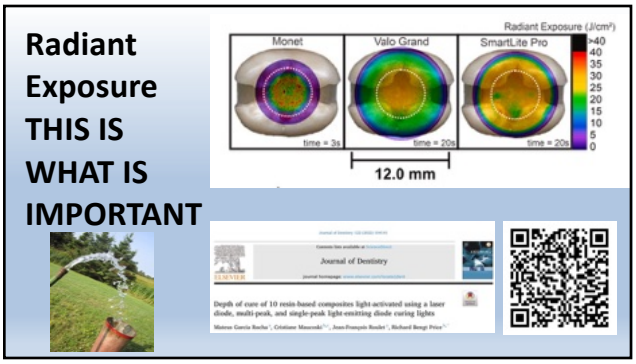
IDEAL G4: BEST ON THE MARKET



155

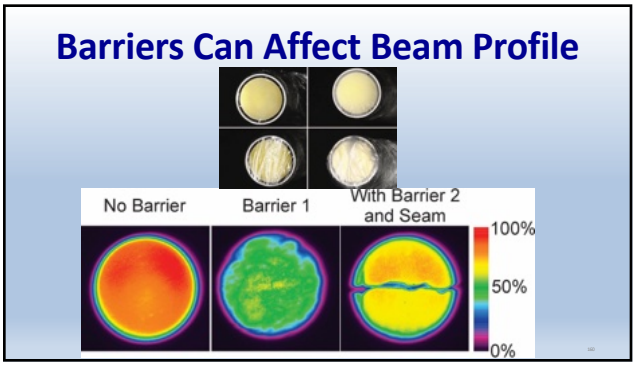


156

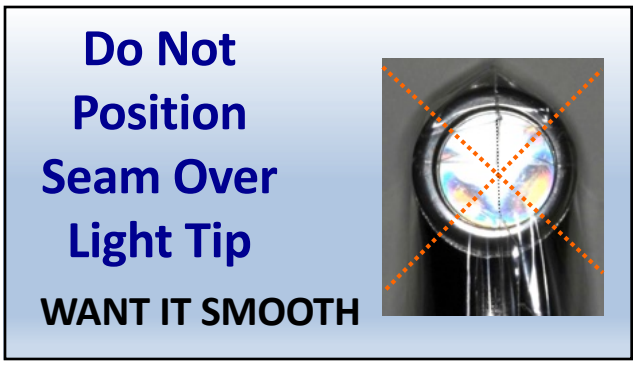


157

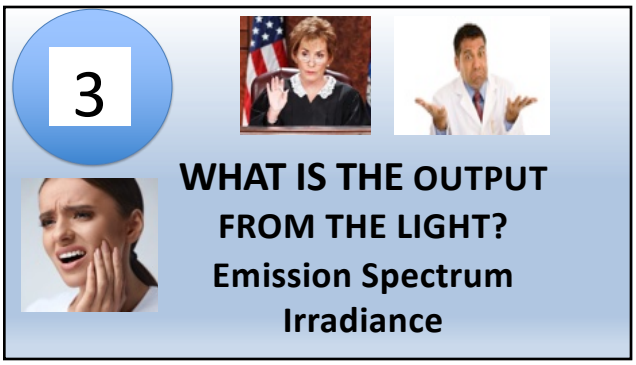
158



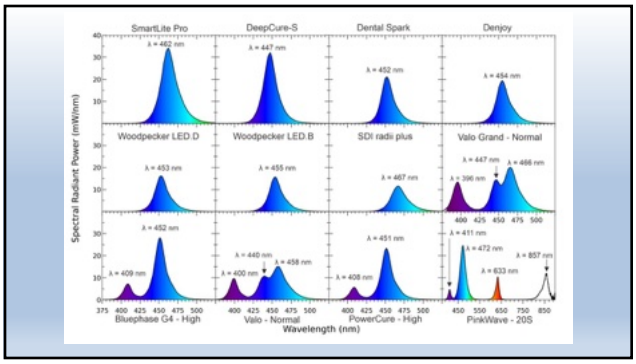
160



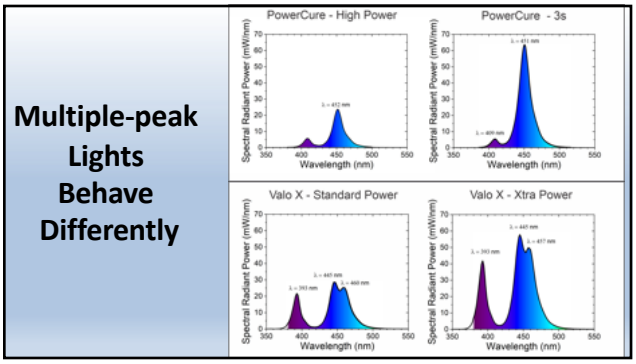
161



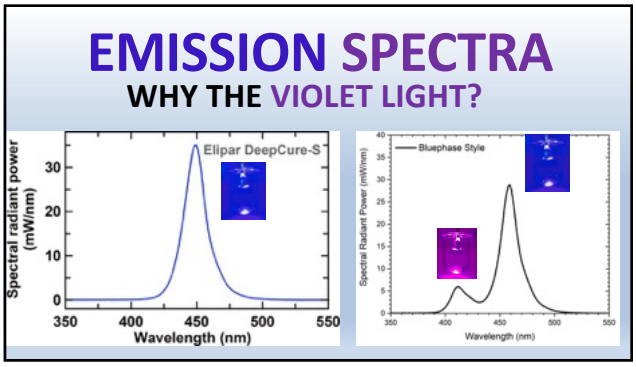
162



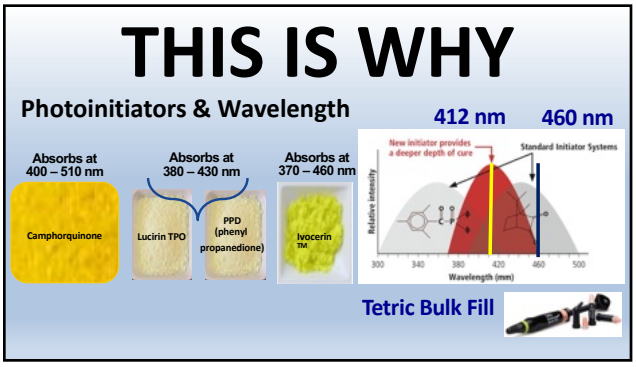
163



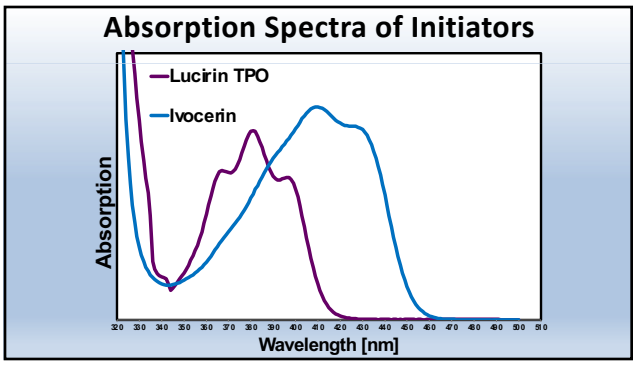
164



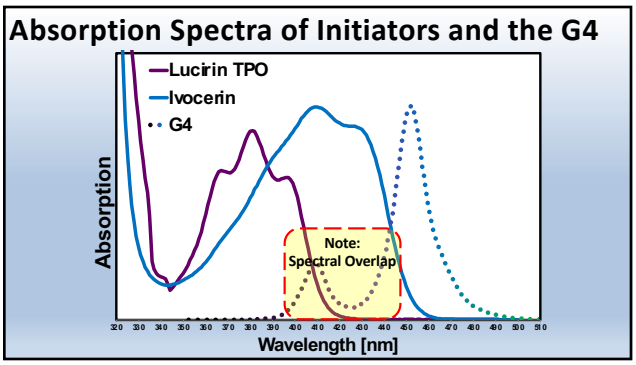
165



166

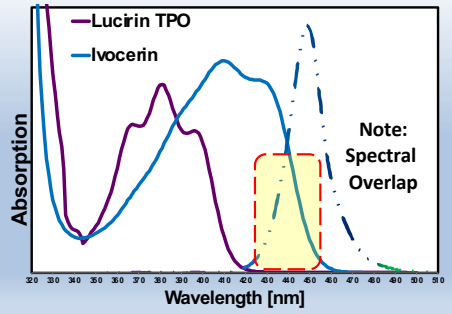


167



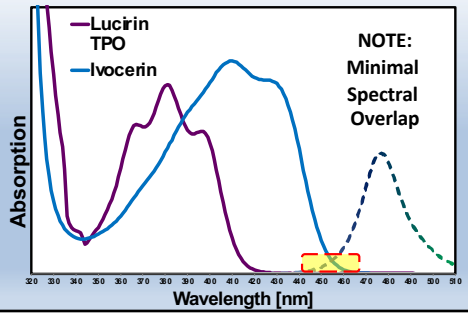
168

Absorption Spectra of Initiators and the DeepCure



169

Absorption Spectra of Initiators and SmartLite Focus



170

Power: Watts (mW)

Power/Area (mW/cm²)

=

Irradiance (mW/cm²)

171

POWER, DIAMETER: Irradiance

9mm: 63.6mm² 6mm: 28.3mm²

πr^2

Same Power Irradiance?

1,100 mW/cm² 2,476 mW/cm²

172

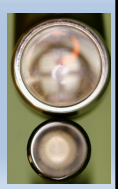
Equate Lbs to Watts

Equate Low Pressure: Low Irradiance

Equate High Pressure: High Irradiance

Same Weight

Different Pressure/ Irradiance



173

Same Lbs:Same Watts

Small Area/High Pressure/High Irradiance

Large Area/Low Pressure/Low Irradiance

Same Weight

Different Pressure/ Irradiance

174

Changing Tip Diameter From 10 to 7 mm

Halves the Area

Diameter	Area (cm^2)	Power (mW)	Irradiance (mW/cm^2)	Diameter	Area (cm^2)	Power (mW)	Irradiance (mW/cm^2)
10	0.786	1000	1273	10	0.786	1000	1273
7	0.385	1000	???	7	0.385	1000	2597

DOUBLES the Irradiance


175

3,000 mW/cm^2 DOES NOT MEAN IT IS A 'POWERFUL' LIGHT

It may just have a small tip **Just Like High Pressure**

176

Irradiance (mW/cm^2)

X

Time (s)

=

Radiant Exposure (mW/cm^2)

177

Power: Watts (W) x Time

=

ENERGY: (J)

Irradiance x Time=

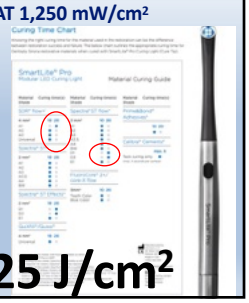
Radiant Exposure (J/cm^2)

https://en.wikipedia.org/wiki/Radiant_exposure

Time =

10s or 20s, Depending on the Product

AT 1,250 mW/cm^2



12.5 - 25 J/cm^2

178

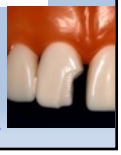
FILTEK SUPREME

Shades	Increment Depth	All Halogen and LED Lights (with output of 400–1000 mW/cm²)	3M™ Elipar™ LED Curing Lights (with output 1000–2000 mW/cm²)
Body, Enamel, Translucent	2 mm	20 sec.	10 sec.
Dentin, A6B and B5B	1.5 mm	40 sec.	20 sec.

Minimum Irradiance x Time = Minimum Radiant Exposure

Body 400 mW/cm^2 x 20s: 8-10 J/cm^2

Dentin 400 mW/cm^2 x 40s: 16-20 J/cm^2



179

Power: Watts (W) x Time

=

ENERGY: (J)

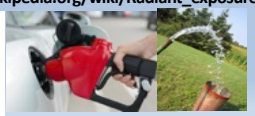
Irradiance x Time=

Radiant Exposure (J/cm^2)

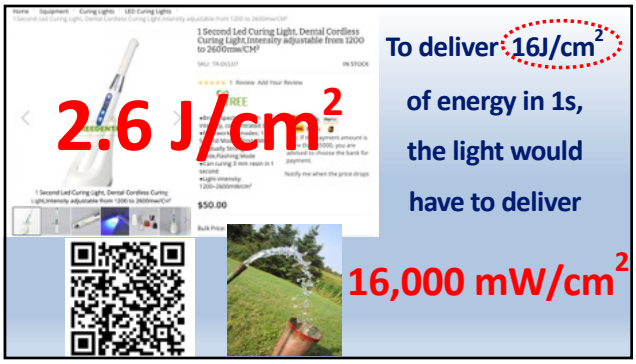
https://en.wikipedia.org/wiki/Radiant_exposure

To deliver 16J/cm^2 of energy in 10s, the light would have to deliver

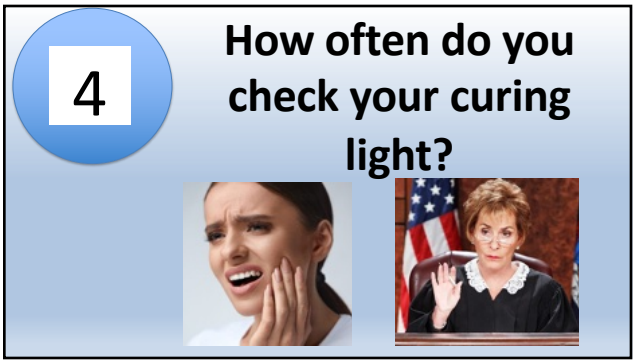
1,600 mW/cm^2



180

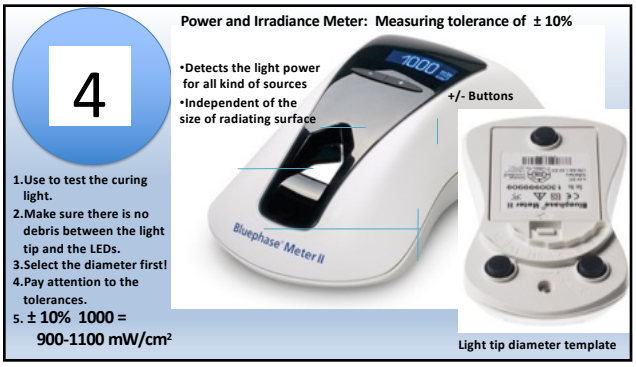


181

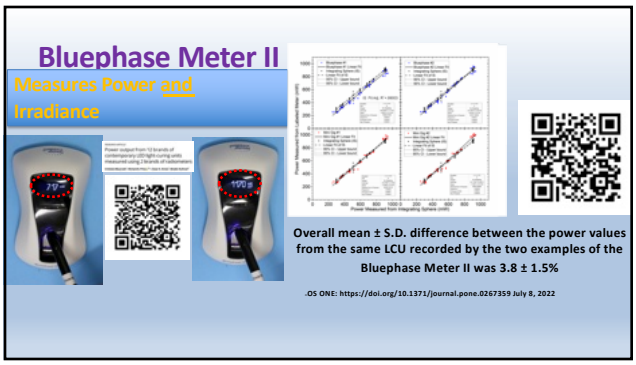


182

183



184



185

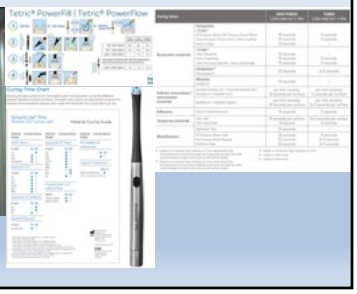
186

5

DID YOU READ THE INSTRUCTIONS FOR USE?


187

FOLLOW MANUFACTURER'S INSTRUCTIONS

188

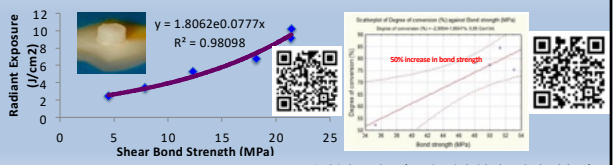
USING THE MOLD TO SHOW THE EFFECT OF DIFFERENT SHADES


A4B


A1B

190

Good Bonding Requires Adequate Light Curing!

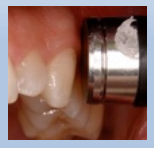
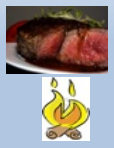
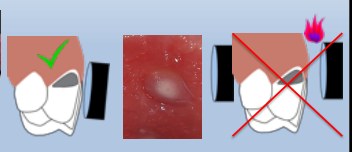
Xu X, Sandras DA, Burgess JO. Shear bond strength with increasing light-guide distance from dentin. J Esthet Restor Dent 2006;18(1):19-27

Correlation between degree of conversion, resin–dentin bond strength and nanoleakage of simplified etch-and-rinse adhesives. Hass et al. Dental Materials 29 (2013) 921–928

191

BUT A Powerful Light Used For Too Long Can Deliver Too Much Energy

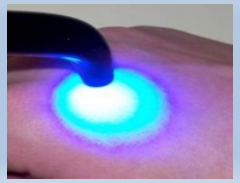
Position Light to Minimize Thermal Damage to Soft Tissues, Air Cool if Needed

192

BEWARE of BURNS

If 10s is max time, then use light for 10s, then allow 5s to cool down, before turning on again




193

BEWARE OF OFF LABEL USE OF DENTAL PRODUCTS

A SAFER DENTAL VISIT

The significance of the US Food and Drug Administration for dental professionals and safe patient care

2017

However, if you decide to use a product off label, this decision should only be taken if there is ample scientific evidence supporting the efficacy and safety of that product.

195

BEWARE OF OFF LABEL USE OF DENTAL PRODUCTS

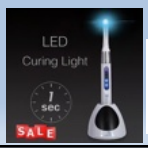
ACADEMY of GENERAL DENTISTRY

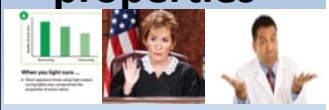
OFF-LABEL USE OF DENTAL PRODUCTS

The Academy of General Dentistry believes that dentists may prescribe or administer legally marketed medical and dental products for an off-label use within the Practice of Medicine Exception, if they believe that such an application is in the best interest of their patient.

196

3M LIGHT CURING GUIDELINES EVEN say that short exposure times may compromise the properties





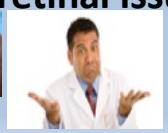
197

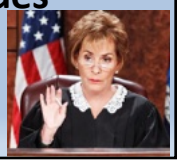
OSHA GENERAL DUTY CLAUSE

198

6

David: You failed to provide adequate eye protection, now I have retinal issues

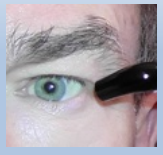




199

THE BLUE LIGHT HAZARD IN DENTISTRY

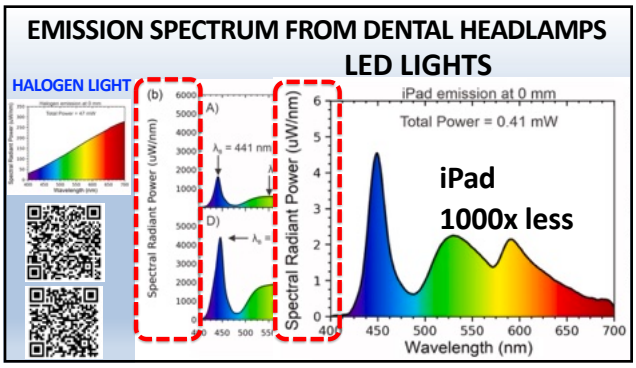
YouTube Video



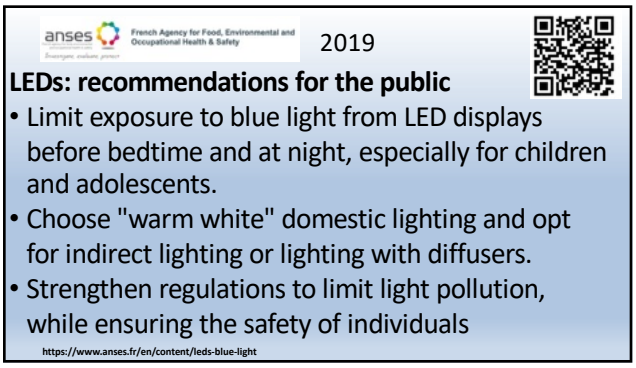
200

201

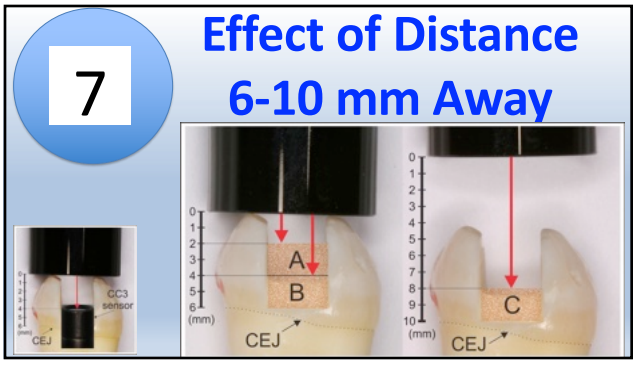
202



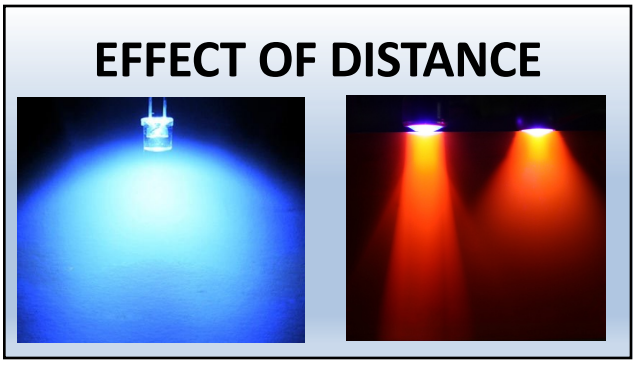
203



205



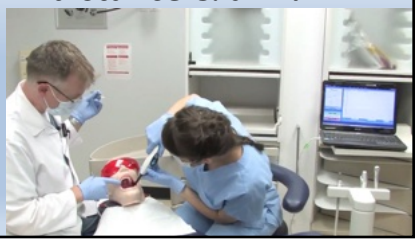
206



207

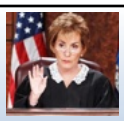
7

Did you train your assistant on the importance of distance & aim?

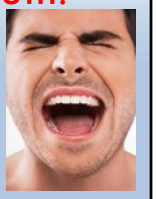


208

8



CAN YOU EVEN ACCESS THE RESTORATION IN THE MOUTH?

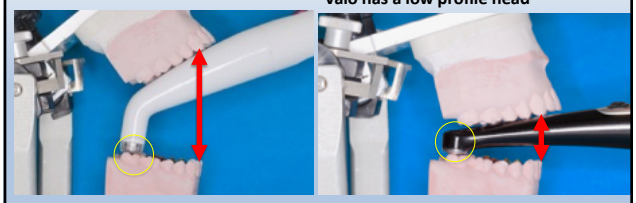


Worst Budget Light Must Open: 65 mm

209

CLINICAL REALITY

Valo has a low profile head



Light Design is Important

210

POOR DESIGN

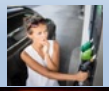
Angles = Shadows = Inadequate Cure

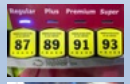
ZERO BOND STRENGTH!
POOR PROPERTIES & MORE TOXIC

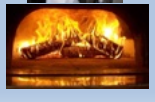
211

SO PLEASE

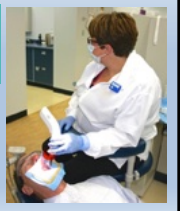
THINK: WHAT YOU ARE PUTTING IN?







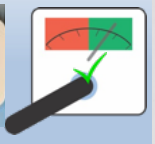
THINK: WHAT ARE YOU CURING?



212

Regularly Check OVEN/Light Output

Check For Damage or Debris on Light Guide



How Many Restorations Will You Replace If You Discover Your Light Has Malfunctioned?

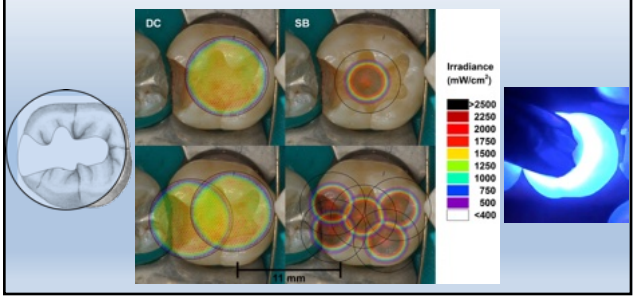
213

3,000 mW/cm^2 DOES NOT MEAN IT IS A 'POWERFUL' LIGHT

It may just have a small tip **Just Like High Pressure**

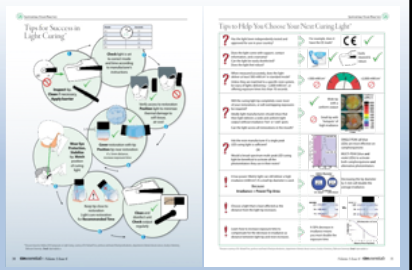
214

LARGE TIP vs. SMALL TIP



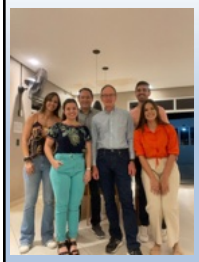
215

FOLLOWING THE INSTRUCTIONS GIVES YOU AN EVEN BAKE

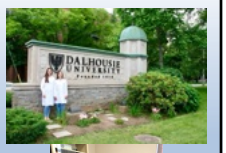


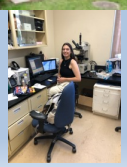
216

Thank You



Acknowledgements
Prof. Marcelo Giannini
Prof Cesar Arrais
Prof. Carlos Soares
Prof. Jack Ferracane
Prof. Howard Strassler
Prof. Daniel Labrie
Prof. Fred Rueggeberg
Dr. Cristiane Maucoski
Dr. Thorsten Bock (Ivoclar)
Dr. Benjamin Gebhard (Ivoclar)
Dr. Joe Oxman (3M)
Dr. Frank Pfefferkorn (Dentsply Sirona)
Neil Jesson (Ultradent)



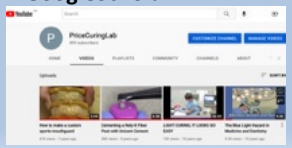


DALHOUSIE UNIVERSITY

217

ANY QUESTIONS?

- rbprice@dal.ca
- YouTube: PriceCuringLab
- GoogleScholar



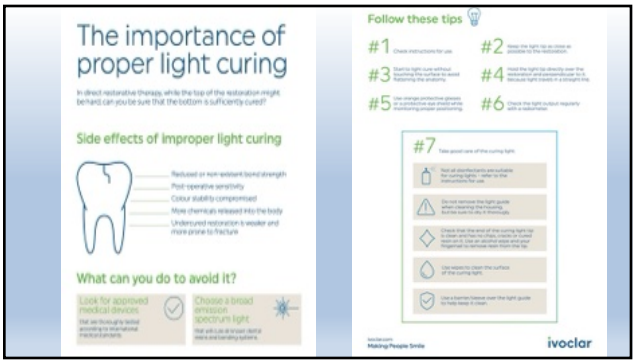
218

KULZER LIGHT CURING GUIDELINES

223

IVOCLAR LIGHT CURING GUIDELINES

225



226

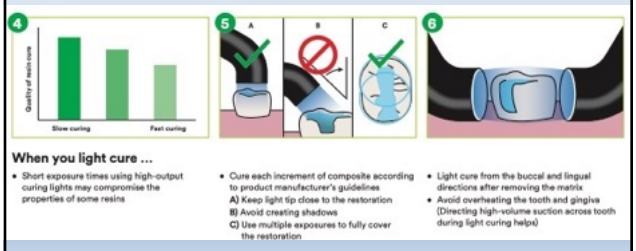
3M LIGHT CURING GUIDELINES

227

3M GUIDELINES

228

3M GUIDELINES



229

YouTube Videos:

Tips to help you choose a curing light

Filling a cavity with a poor technique

How to avoid knit lines in your composites

230