Composite Heating Articles Summary

Past major issues with composite restorations have included:

a. Reducing the curing (polymerization) time
b. Increasing the depth of cure
c. Increasing the conversion (polymerization) ratio

1. Bortolotto and Krejci: The effect of temperature on hardness of a light-curing composite.

J Dent Res. 2003;82 (special issue A). Abstract 0119.
http://webcache.googleusercontent.com/search?q=cache:lSALgp45MG0J:www.addent.com/docs/article_3.pdf+&cd=2&hl=en&ct=clnk&gl=us

a. The restorations inserted with the composite prewarmed to 40C (104F) were significantly harder on the Vicker's scale than the composite restorations inserted at room temperature (22C)
b. The hardness values at 40C compared with those where the composite was 5C (approximate temp of a commercial refrigerator) were approximately double
c. Curing time for a layer of composite at room temperature could be reduced to half when it was warmed to 40C without affecting its hardness properties
d. Therefore, prewarming a restorative composite to a temperature slightly greater than 37C can improve the depth of cure of the material and reduce the curing time by 50%

2. Trujillo and Stansbury: Thermal effects in composite photopolymerization monitored by real-time NIR.

J Dent Res. 2003; 82 (special issue A). Abstract 0819.
http://iadr.confex.com/iadr/2003SanAnton/techprogram/abstract_27111.htm

a. A higher conversion ratio (double-bond formation or polymerization) at a greater depth increases the material modulus, resulting in less flexure and less potential for restoration fracture under loading.
b. This was true for microfill, hybrid, and packable composites cured by LED, halogen, or plasma arc at two different temperatures (23C/73F and 54.5C/130F)
c. The curing time required to achieve similar conversion ratios could be decreased by 50-80% when the temperature of the composite was elevated from 23C to 54.5C
d. Therefore, prewarming a restorative composite to a temperature greater than 37C can improve the conversion rate of the material, with a concomitant improvement in the fracture resistance, and reduce curing time by 50% or more

3. Holmes et al: Composite film thickness at various temperatures.

J Dent Res. 2004; 83 (special issue). Abstract 3265.

http://www.ncbi.nlm.nih.gov/pubmed/17174660

a. When the filling material was at body temperature, the next 20C of warmth did not reduce the curing time significantly. At 58C/136F another major advance in the conversion ratio remained constant for the next 10C.

b. This indicates that the ideal warming of a composite should be either 37C or 58C

c. The ideal prewarming temperatures for a restorative composite are scientifically established, and most curing times for a prewarmed composite can be reduced to 20 seconds

d. The film thickness of a microhybrid composite decreased by approximately 30% when the material was heated to 54C/129F.

e. The low viscosity of flowable composites is achieved by decreasing the filler concentration, which in turn increases the proportion of resin in the composite resin and ultimately polymerization shrinkage

f. Thus it becomes possible to use a flowable and highly filled prewarmed hybrid or packable composite at the gingival margins of a deep restoration

g. Maximum intrapulpal temperature rise from the application of a 57.2C/134.9F composite material was approximately 1.6C, well within the established pulpal tolerance of more than 10C

5. Littlejohn et al: Curing efficiency of a direct composite at different temperatures.

J Dent Res. 2003; 82 (special issue A). Abstract 0944.

a. A significant improvement in conversion from room temperature to body temperature was found

b. Therefore, a composite warmed at least to 37C before insertion into the tooth cavity is likely to be a better restoration with improved physical properties, both in the short and long term

6. Papacchini et al: Effect of intermediate agents and pre-heating of repairing resin on composite-repair bonds. Operative Dentistry. 2007: 32-4; 363-371.

http://www.ncbi.nlm.nih.gov/pubmed/17695609

a. The combination of a flowable composite as an intermediate agent and a repairing material at a temperature of 23C or 37C prior to light curing may be recommended as a simple, suitable procedure to provide higher bond strengths and uniform composite-to-composite interfacial adaptation

b. The use of cooled (4C) microfilled hybrid composite as a repairing material resulted in poor composite-to-composite interfacial adaptation and lower repair strengths. The difficult adaptation of a highly viscous material to the roughened or intermediate agent-covered substrate probably explains these results

c. Preheating of the repairing material to 37C significantly enhanced repair strengths when no intermediate agent was used. Lower viscosity, achieved by heating the composite, may also justify the uniform composite-to-composite interfacial adaptation observed.

d. The use of a low-viscosity flowable composite as an intermediate agent resulted in a significant improvement in reapir strength under each of the three temperature conditions (4C, 23C, 37C) of the repairing resin

7. Wagner et al: Effect of pre-heating resin composite on restoration microleakage.

Operative Dentistry. 2008: 33-1; 72-78.

http://www.ncbi.nlm.nih.gov/pubmed/18335736

a. Preheating composites can improve adaptation of resin composites to tooth structure. This technique significantly reduced microleakage. However, delaying light curing of preheated composite after placement appears to be counterproductive and diminishes the positive effects from the preheating treatment. Flowable liner was less effective than preheating the composite in reducing microleakeage.

More links to: # Composite Heating Study Data

Color stability, opacity and degree of conversion of pre-heated composites.
http://www.ncbi.nlm.nih.gov/pubmed/21163324
Mundim FM, Garcia Lda F, Cruvinel DR, Lima FA, Bachmann L, Pires-de-Souza Fde C.
J Dent. 2011 Jul;39 Suppl 1:e25-9. doi: 10.1016/j.jdent.2010.12.001. Epub 2010 Dec 14.

Effect of pre-heating on depth of cure and surface hardness of light-polymerized resin composites.
http://www.ncbi.nlm.nih.gov/pubmed/18795516
Muñoz CA, Bond PR, Sy-Muñoz J, Tan D, Peterson J.; Am J Dent. 2008 Aug;21(4):215-22.

Effect of pre-heating on the viscosity and microhardness of a resin composite.
http://www.ncbi.nlm.nih.gov/pubmed/20050987
Lucey S, Lynch CD, Ray NJ, Burke FM, Hannigan A.
J Oral Rehabil. 2010 Apr;37(4):278-82. doi: 10.1111/j.1365-2842.2009.02045.x. Epub 2009 Dec 29.

Relationships between Conversion, Temperature and Optical Properties during Composite Photopolymerization.
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2862770
Benjamin Howard, Undergraduate student, Nicholas D. Wilson, Undergraduate student, Sheldon M. Newman, DDS, MS, Associate Professor, Carmem S. Pfeifer, DDS, PhD, Post-doctoral fellow, and Jeffrey W. Stansbury, PhD, Professor

Monomer conversion of pre-heated composite.
http://www.ncbi.nlm.nih.gov/pubmed/15972598
Daronch M, Rueggeberg FA, De Goes MF.; J Dent Res. 2005 Jul;84(7):663-7.

Effect of composite temperature on in vitro intrapulpal temperature rise.
http://www.ncbi.nlm.nih.gov/pubmed/17197016
Daronch M, Rueggeberg FA, Hall G, De Goes MF.; Dent Mater. 2007 Oct;23(10):1283-8. Epub 2007 Jan 2.

Polymerization kinetics of pre-heated composite.
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Daronch M, Rueggeberg FA, De Goes MF, Giudici R.; J Dent Res. 2006 Jan;85(1):38-43.

Composite pre-heating: effects on marginal adaptation, degree of conversion and mechanical properties.
http://www.ncbi.nlm.nih.gov/pubmed/20557926
Fróes-Salgado NR, Silva LM, Kawano Y, Francci C, Reis A, Loguercio AD.
Dent Mater. 2010 Sep;26(9):908-14. doi: 10.1016/j.dental.2010.03.023. Epub 2010 Jun 16.

Effect of pre-heating composite resin on gap formation at three different temperatures.
http://www.ncbi.nlm.nih.gov/pubmed/21814365
Choudhary N, Kamat S, Mangala T, Thomas M.; J Conserv Dent. 2011 Apr;14(2):191-5. doi: 10.4103/0972-0707.82618.

Effect of pre-heating resin composite on restoration microleakage.
http://www.ncbi.nlm.nih.gov/pubmed/18335736
Wagner WC, Aksu MN, Neme AM, Linger JB, Pink FE, Walker S.; Oper Dent. 2008 Jan-Feb;33(1):72-8. doi: 10.2341/07-41.

In vivo temperature measurement: tooth preparation and restoration with preheated resin composite.
http://www.ncbi.nlm.nih.gov/pubmed/21029335
Rueggeberg FA, Daronch M, Browning WD, DE Goes MF.; J Esthet Restor Dent. 2010 Oct;22(5):314-22. doi: 10.1111/j.1708-8240.2010.00358.x.