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CLINICAL EXCELLENCE

Clinical benefits of pre-warmed composites

COMPOSITES ARE BECOMING INCREASINGLY PREVALENT IN THE DENTAL SURGERY. GEORGE FREEDMAN REPORTS ON RECENT RESEARCH INTO LIGHT CURING

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Increasingly, our patients are demanding composite restorations instead of traditional amalgam fillings. Anterior composites, restorations in the teeth that are visible upon smiling, have been the standards of practice for many years. For the less visible posterior teeth, it is estimated that in North America, the significant 50% mark for composite restorations in the posterior region was surpassed sometime in the year 2000.

The ubiquitous presence of tooth-coloured fillings, and their coverage in the public media, has galvanised patient interest in their own dental health, as well as a more educated demand for quality dentistry. These successful dental advances are the results of a science that is based on very active academic and private research and development, constantly evolving materials and techniques for better patient treatment. These new parameters for effective practice have placed the additional burdens of technique and dental material awareness upon the practitioner. Each dental professional assumes the responsibility of keeping abreast of the latest innovations for the benefit of his or her patients.

As dentists have increasingly switched to composite restorations, they have advocated improved properties in these materials. Much of the research of the past few years has been focused on answering the dental practitioners' concerns by both improving the quality and the ease-of-use of composite resin materials in dental restorations. The ultimate clinical objective is a restoration that is relatively easy to place (not technique sensitive), convenient to polymerise, long-lasting and aesthetic. The most pertinent issues have included:

- Reduction of curing (polymerisation) time
- Improvement of the depth of cure
- Improvement of the conversion (polymerisation) ratio.

Through the past two decades, much of the attention has been focused on parameters such as curing light intensity, curing time, curing light application format, and the presence of moisture in the restorative field. There has been little attention paid to the properties of the directly-placed composite under varying thermal conditions. This is rather surprising, considering that the physical property advantages of heat-curing composites in the manufacture of extraorally fabricated inlays and onlays have been long been established.

Over the years, dentists were often asked to refrigerate their composites until just immediately prior to use, and in between patients, as well. According to the latest research findings on the subject of composite placement, this is probably the worst possible course of action. To the contrary, the warming of composites immediately prior to placement with a Calset thermal assist unit (Addent Inc, Danbury CT) has been shown to improve composite properties and reduce curing times.

During the evaluation of the bottom hardness of composites that were cured with a range of light sources, varying only the composite temperature at the moment of polymerisation (TMP), Bortolotto and Krejci (2003) found that the insertion temperature had an important influence on the hardness of a composite. The restorations that were inserted with the composite pre-warmed to 40ºC (only 3ºC warmer than body temperature, and therefore quite comfortable even in unanaesthetised teeth)

Figure 1: Calset Composite warming unit

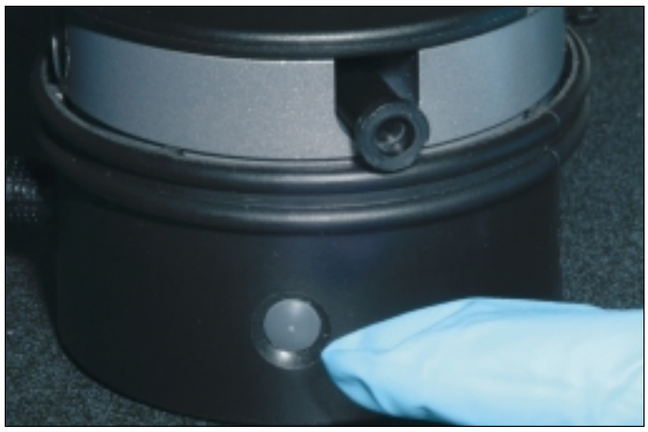

Figure 2: Calset control switch

Figure 3: Loading warmed compule into syringe gun

were significantly harder on the Vicker's scale than the composite restorations that were inserted at room temperature (22ºC). The hardness values at 40ºC were approximately double those where the composite was at 5ºC (selected because this is the approximate temperature of a commercial refrigerator). Another very clinically important finding was that the curing time for a standard 2mm layer of composite at room temperature (22ºC) could be halved when it was warmed to 40ºC, without affecting its hardness properties (Bortolotto & Krejci, 2003).

The clinical significance of the above is that pre-warming restorative composite to slightly above body temperature can improve the depth of cure of the material *and* reduce curing time by 50%.

The conversion values of composites studied by Stansbury under various thermal conditions provided even more dramatic results (Trujillo & Stansbury, 2003). A higher conversion ratio, (or double bond formation, or polymerisation) to a greater depth increases modulus of the material. This results in less flexure, and less potential for restoration fracture under loading. Three aesthetic materials (microfill, hybrid, packable) were compared under three different light curing modes (LED, halogen, plasma arc) at two different temperatures (23ºC & 54.5ºC). The research found that the elevated temperature of the composite during photopolymerisation resulted in substantially higher immediate and final conversion values in all the tested composite materials, and with all the different curing lights. Surprisingly, the curing time required to achieve similar conversion ratios could be decreased by as much as 50 to 80% when the temperature of the composite was elevated from 23ºC to 54.5ºC.

The clinical significance of the above is that pre-warming restorative composite filling material to above body temperature can improve the conversion rate, with a concomitant improvement in the fracture resistance, of the material *and* reduce curing time by 50% or more.

A study by Rueggeberg (2003) has demonstrated that composite TMP has a major impact on the polymerisation times required. Interestingly, once the filling material was at body temperature, the next 20ºC of warmth did not significantly reduce the curing time. At 58ºC there was another major advance in the conversion ratio, which then remained constant for the next 10ºC. This indicates that ideal warming of composite should be to the lower levels of each of these thermal windows, either body temperature (37ºC) or a slightly more elevated temperature (58ºC). For pre-warmed restoratives, there was no significant increase of conversion values as the curing times were increased from 20 seconds to 60 seconds. Thus, effective and clinically efficient shorter curing times can be recommended.

The clinical significance of the above is that the ideal pre-warming temperatures for restorative composites are now scientifically established, and that most curing times for pre-warmed composites can be reduced to 20 seconds.

Littlejohn et al (2003) measured the percentage of composite conversion at various TMP levels. They found that there was a significant improvement in conversion from room temperature to body temperature.

The clinical significance of these studies is the clear finding

Figure 4: Amalgam with redecay and marginal breakdown

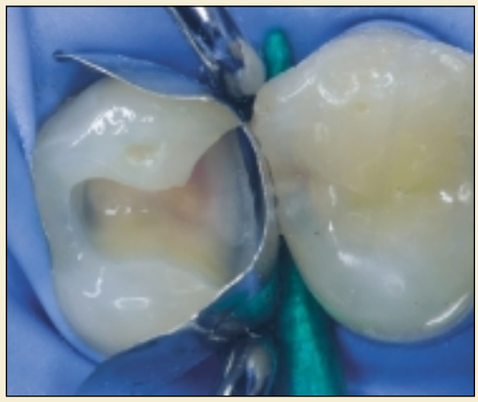

Figure 5: Preparation is isolated with a rubber dam and sectional matrix

Figure 6: Applying iBond seventh generation adhesive

Figure 7: A pre-warmed microhybrid is flowed into the marginal areas and cured

that composite that is warmed at least to body temperature prior to insertion in the tooth cavity is likely to be a better restoration with improved physical properties, both in the short and the long term.

In the past ten years, the targeted use of flowable resins in large posterior restorations has been helping to achieve better marginal adaptation, particularly with packable composites. But this technique involves a restorative compromise: the low viscosity of the flowable composite is achieved by decreasing the filler concentration, and altering the filler shape. This, in turn, increases the proportion of resin in the composite resin, increasing the polymerisation shrinkage upon curing.

Viscoelastic materials such as composite resin exhibit decreased viscosity and greater flowability with an increase in temperature In a study by Rueggeburg (2003), the film thickness or Herculite decreased by approximately 30% when the material was heated to 54ºC. Thus, it is possible to use a pre-warmed hybrid that is both flowable and highly filled, at the gingival margins of a deep restoration, eliminating a technical compromise that has existed for several years.

One concern that arises is the effect of the pre-warmed composite heat on the dental pulp, and the possibility of iatrogenic thermal damage. A study by Rueggeberg (2003) indicated that the maximum intrapulpal temperature rise from the application of a 57.2ºC composite material was approximately 1.6ºC, well within the established pulpal tolerance of more than 10ºC (Zach & Cohen, 2002).

CLINICAL TECHNIQUE

The preparation for pre-warming composite to the ideal TMP is quite simple:

- The Calset unit is turned on (press the control switch once). Note that the amber LED indicator illuminates to indicate that the unit is functioning normally
- The green LED begins to flash to indicate the warming of the composite, which will typically take approximately 10 minutes to reach 55°C or 130°F
- Once the desired temperature has been reached, the green light will shine steadily
- The heated composite compule is then loaded into the syringe gun and the material is applied directly to the tooth.

The amalgam restoration (Figure 4) shows signs of redecay and marginal breakdown. The old filling is removed, and the preparation is isolated with a rubber dam and a sectional matrix (Figure 5). The preparation is treated with iBond (Heraeus-Kulzer, Armonk NY), a 7th generation, single bottle and single step adhesive that requires no acid etching (Figure 6). A pre-warmed microhybrid, Venus (Heraeus-Kulzer, Armonk NY) is flowed into the marginal areas and cured (Figure 7). In the past, heavily filled materials, particularly packables, have had difficulty in achieving good marginal adaptation (Opdam et al, 2002). A pre-warmed microhybrid has the consistency of a flowable, conforming to the marginal areas very accurately. The adaptation of the pre-warmed composite into the nooks and crannies of the preparation is improved as a result of its elevated temperature flowability. As each increment of composite is placed and cured at its ideal TMP, the elevated temperature curing will provide the improved physical and mechanical properties described above. The composite is placed in increments in accordance with conventional techniques until the occlusal surface is completed. It is then finished and routinely polished (Figure 8).

The upper segment of the

Figure 8: The completed restoration

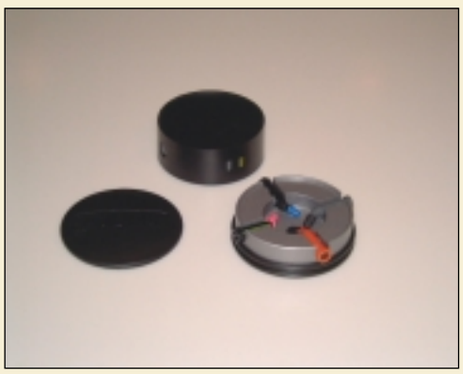

Figure 9: The top segment of the Calset can be removed and transported independently

Calset unit can be removed from the heater and transported independently to a location remote from the base (Figure 9). There are no electrical cords to this part of the unit. The design of the Calset allows the upper segment to act as a heat sink that will keep the composite warm for several minutes. In case the composite is forgotten in the Calset unit, there is no negative effect on the properties of the composite, even after eight hours of warming.

The era of curing composites under elevated thermal conditions, long accepted and practised during the fabrication of extraoral composite restorations is now available for direct intraoral composite restorations. The early research, confirmed by clinical practice, indicates that this is a practical and effective means of rapidly and easily improving composite properties in dental restorations.

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George Freedman will be speaking at the World Aesthetic Congress which is taking place in London on 6 and 7 June. For last minute ticket availability, telephone 0800 371 652

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Q1
TMP is an acronym for what?
a) Temperature at mid-phase
b) Temperature of the moment of preparation
c) Temperature at the moment of polymerisation
d) Temperature of materials and products

Q2
In the study by Bortolotti & Krejci (2003), the restorations that were inserted with the composite pre-warmed to 40ºC were what compared to composites inserted at room temperature?
a) Significantly harder on the Vicker's scale
b) Significantly softer on the Vicker's scale
c) About the same on the Vicker's scale
d) There were no conclusive results

Q3
In a study by Rueggeberg (2003), the film thickness or Herculite decreased by how much when the material was heated to 54ºC?
a) Less than 10%
b) Approximately 30%
c) Approximately 50%
d) Approximately 70%

Q4
What does the author state as being the established pulpal tolerance temperature?
a) 5ºC
b) 10ºC
c) 15ºC
d) 20ºC

Q5
How does the Calset unit indicate that the desired temperature has been reached?
a) The green light goes off
b) The green light flashes
c) The green light shines steadily
d) The red light flashes