

# Devices & Methods for pre-heating/pre-warming Dental Resin Composites: A Critical Appraisal

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## ABSTRACT

The pre-warming / pre-heating of dental composite resins prior to placement was recently proposed to improve the workability and properties. Pre-heating is done with placement of composite compules or syringes into a heating device. The use of this method leads to eased extrusion as well as enhances resin adaptation to the walls of preparation as compared to the resin used at room temperature. For pre-heating of dental composite resins, very few devices are available in market, and the data regarding their use is also limited. This critical review critically discusses all the devices available in the market and our own innovatively designed simple and economically viable devices are also described.

**KEYWORDS:** Pre-heating, pre-warming, composite, resin, calset, thermaflo, dental

## INTRODUCTION

The pre-warming / pre-heating of dental composite resins prior to placement was recently proposed to improve the workability and properties. Pre-heating is done with placement of composite compules or syringes into a heating device. The use of this method leads to eased extrusion as well as enhances resin adaptation to the walls of preparation as compared to the resin used at room temperature.<sup>1-3</sup>

Pre-heating of dental resin composites has many advantages. The flow of dental resin composites greatly increases after pre-warming<sup>1,4</sup> The rate of monomer conversion increases significantly

upon increasing composite resin temperature. The pre-heated material achieves higher monomer conversion even with less energy, allowing reduction of light exposure duration up to 75%. Previous research has shown no effect on monomer conversion when repeated, or extended pre-warming cycles are used for resins, indicating that there is no degradation of components of the resin during pre-heating.<sup>4</sup> Nevertheless, the temperature rise is less than 1.0°C invitro was observed when the composite resin was preheated to 60°C compared with the composite resin used at room temperature.<sup>5,6</sup>

For pre-heating of dental composite resins, very few devices are available in the market, and the data regarding their use is also limited. This critical review will critically discuss all the devices available in the

market and our own innovatively designed simple and economically viable devices will also be described.

## PRE-HEATING / PRE-WARMING DEVICES AND METHODS

**1. Calset Composite Warmer:** Calset composite warmer (AdDent, Inc., Dandury, CT, USA) is the most popular, widely reported in literature and effective device to preheat dental composite resins.<sup>1-8</sup> This device can heat the resin to 37°C, 54°C and 68°C and also maintains a constant temperature as needed by the clinician. Calset Tri Tray warms compule in a dispenser gun as well as it warms two composite instruments. It also holds and warms three extra compules. Using the AdDent Co Max dispenser, the compule is used from the tray without touching it, however, other dispensers can be used for heating purposes. Other available trays in this system are Porcelain Veneer Tray, Anesthetic Tray, and Syringe Tray.<sup>7</sup>

The efficacy of Calset Composite Warmers was investigated by Daronch and co-workers<sup>4</sup>. The device operates at two temperature settings for pre-heating composite: 54°C & 60°C. However, the highest temperature attainable for compules with hybrid composites was 48.3°C when the device was set to 54°C, & 54.7°C when set to 60°C.<sup>4</sup>

**Clinical Technique with Calset device<sup>7</sup>:** The preparation for pre-warming a composite to the ideal

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polymerization temperature is rather straightforward.

- The Calset unit is turned on and observe that the amber LED indicator illuminates to indicate that the unit is functioning normally.
- The green LED flashes to indicate the warming of the composite, which typically takes approximately 10 minutes to reach 55°C.
- When the desired temperature has been reached, the green light shines steadily.
- The heated composite compule is loaded into the syringe gun, and the material is applied directly to the tooth.

**2. Therma-Flo™ composite warmer (Vista dental, USA)<sup>9</sup>:** Therma-Flo™ has Composite Applicator™ with automated delivery and the Composite Warming Kit for clinical use. Composite Applicator™ has patented design for motorized extrusion of the warm composite. The tip also gets heated to keep material warm for optimal flow of resin composite. Designed to enhance the performance of Therma-Flo™ products, Vista's Step Down tips have an added advantage of extended length for access in deeper areas with more precision while placement. They have unique design to accomodate most composite capsules, Step Down tips represent a major step forward in the control of composite delivery. The tips are available in two sizes 2X and 4X to reach even deeper areas.

**3. Light of dental unit:**As suggested in article by Myoung-Uk Jin<sup>8</sup>, composite resin if placed under the light of the dental chair, the temperature of composite resin rises. But in our opinion, this increase is not that significant to be applied in clinical practice.

**4. Hand holding:** As suggested in an article by Myoung-Uk Jin<sup>8</sup>, if composite resin syringe or compule is wrapped by hands for 3-5 minutes, the temperature of resin rise slightly. Some researchers suggest rubbing the composite syringe in between hands to generate heat to increase the temperature of resin composite<sup>8</sup>. But in our opinion, this increase is not that significant to be applied in clinical practice.

**5. Hot water bath:** This method is not clearly described in literature.<sup>10</sup> We have tried this method and found it be effective for use. The only factor is the control of the temperature of water. We have tried to use a controlled temperature water bath for the purpose, and it works as per the requirement. The limitation is that it is too cumbersome to use and water drips from the syringe. Drying the syringe wastes time and the temperature of composite gets decreased during this delay. However, if no other device is available in the dental clinic, this is the most inexpensive method which can be used to derive the benefit of composite pre-heating.

**6. Use of thermocycling apparatus:** This method is not described in the literature. We have tried this method and found it be effective for use. This equipment is usually available in the dental academic institutes for research

The disadvantage is that it is cumbersome to use and water drips from the syringe. Drying the syringe wastes time and the temperature of composite gets decreased during this delay. The control of temperature is excellent.

**7. Use of microwave oven:** This method is also our own innovation wherein we have used the normal microwave oven in both settings – microwave and grill. Even a 30 seconds exposure in a microwave oven is sufficient for 65°C. We tried the grill option; it takes a little longer time up to 5 minutes to reach the required temperature. However, other factors such as the position of syringe also affect the temperature of the composite. The power settings also have an effect on composite temperature. The effect of microwaves on dental composite resins is as such is not described in the literature so far.

**8. Use of modified glass bead sterilizer:** In this simplified modification, we have used a glass bead sterilizer. The glass beads are replaced with common salt. The glass beads retain the heat, but when it comes in contact with the plastic of syringe, it sticks leading to aggregation of glass beads to the syringe. So, we replaced it with the salt.<sup>11</sup>

The glass bead sterilizer has thermocouple inside in the circuit which can be altered with the help of an electrician as per required temperature settings which can be varied as per the clinician requirement. In the present scenario, we have modified the settings to 65°C.

It takes 10 minutes to pre-heat, and once the unit is warm, it takes 2-3 minutes to warm the composite.<sup>11</sup> A standard composite compule, a syringe option, or pre-loaded compule guns from different manufacturers can be directly used.

**9. Use of wax warmer:** In this innovative and simple technique, we have used a wax melter. The wax is replaced with common salt. The wax melter has temperature settings which can be varied as per the clinician requirement. It takes 10 minutes to pre-heat, and once the unit is warm, it takes 2-3 minutes to warm the composite.<sup>12</sup>

**10. Use of hair dryer:** In this simple technique, we have used a commonly available hair dryer to warm the syringe and compules. This preheats the resin, but the temperature cannot be predicted depending upon the time of use and proximity to the source of hot air. In the situation, wherein no other device is available, this could be a good option to choose as this is handy and is not cumbersome to use. We reported a temperature rise up to 45°C after 3-5 minutes of exposure to hot air.

## STORAGE OF COMPOSITE RESIN SYRINGES/COMPULES IN HEATING DEVICE

It is possible to store syringes and compules in the warming device at the chosen preset temperature for the entire working day in a clinic. However, there are some

practical limitations to this extended storage of resin at higher temperatures.

Composites do not undergo spontaneous polymerisation till the temperatures of 140°C-200°C,<sup>13</sup> and reactant evaporation and photoinitiator degradation does not occur until nearly 90°C.<sup>14,15</sup> On prolonged heating, some low molecular weight parts of the photo-initiator system can get volatilised, thus compromising the light polymerization which follows.

Trujillo<sup>13</sup> mentioned that following eight hours of storage at 54.5°C, composites exhibit reduced conversion when light polymerized as compared to composites stored at the room temperature, Storage at 54.5°C for four hours exhibited no adverse effect. So, it is better to limit the storage time to four hours & to replace compule caps to avoid the potential for components which are reactive to volatalise.<sup>13</sup>

## DISCUSSION

Significant improvements in the physical and mechanical properties of restorative materials have improved the clinician's ability to place a direct composite resin restoration. Direct composite resins have gained widespread use in the dentistry, but not without a proper learning curve. Proper techniques for placement, as well as respect for the resin chemistry, must be appreciated and reproduced in order to achieve the desired result. Research has proven that using new thermal assisted technology by pre-warming resins before placement yields advantages such as improved flow, better adaptation and decreased microleakage, higher polymerization conversion, increased hardness, and a significant reduction in the curing time.<sup>1-4</sup> As a result of pre-warming, these attributes will help the dentist in creating longer lasting resin restorations.

The most commonly used device as reported in the literature till date is Calset and can be called as a benchmark for comparison to other devices. Recently, the manufacturer has done various modifications to increase its applications for ease of use for the operator. In our opinion, the device lacks a digital display so the operator is not aware of unit temperature at all the times as the temperature of the clinic, use of the fan, air conditioners can affect its temperature. It also lacks automated delivery option and the provision to retain heat till the delivery point in the tooth is also not there. The device needs more refinement and innovations.

In comparison to the thermaflo, it is more compact to use. Thermaflo has the automated delivery and the tips to deliver in difficult access positions in the cavity. Thermaflo also lacks digital display. As discussed earlier as well, hand-rolling and the use of chair light are also not predictable methods, and the temperature rise is not that significant.

Use of hot water is the simplest and easiest to use but not very practical as drying the syringe decreases the temperature. Regarding the microwave oven, research is

needed to further investigate the effect of microwaves on resin chemistry. Thermocycling apparatus is also cumbersome to use and is not available in clinics.

However, a wax warmer with digital display and varied setting options can be a good and inexpensive alternative to devices such as calset and thermaflo. Similarly, a modified glass bead sterilizer can also serve the purpose in the easiest way. In some of the countries, the cost and availability of the device is a limiting factor in its use which can be overcome by using the simpler devices commonly available in all clinics. The wax or glass bead compartment is filled with salt. The replacement of salt in the device is useful for retaining heat, and it's a normally available thing. Regarding the price, it hardly costs 10 dollars which mean 50 times less as compared to calset and thermaflo.

Regarding the storage of composites in heating devices, as mentioned earlier as well, it is not advisable to leave the composite syringe or compule in the warming unit as it may cause changes in the matrix.<sup>13-15</sup>

## CONCLUSION

Calset is the most popular composite pre-heating device. Thermaflo has some advantages such as automated delivery and heated tips with varied designs for deeper access. There are some simpler methods such as hot water bath, hot air blower, microwave oven which can be used in the absence of other devices. However, the innovative suggested devices such as wax warmer and modified glass bead sterilizer are also promising and practical especially in countries where cost is a major concern for use of these newer techniques.

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