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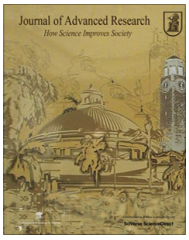

ORIGINAL ARTICLE

Effect of preheating of low shrinking resin composite on intrapulpal temperature and microtensile bond strength to dentin

Heba A. El-Deeb, Sara Abd El-Aziz, Enas H. Mobarak *

Restorative Dentistry Department, Faculty of Oral and Dental Medicine, Cairo University, Egypt

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ABSTRACT

The effect of preheating of the silorane-based resin composite on intrapulpal temperature (IPT) and dentin microtensile bond strength (μTBS) was evaluated. For the IPT, teeth (n = 15) were sectioned to obtain discs of 0.5 mm thickness (2 discs/tooth). The discs were divided into three groups (n = 10/group) according to the temperature of the Filtek LS™ silorane-based resin composite during its placement, either at room temperature (23 ± 1 °C) or preheated to 54 °C or 68 °C using a commercial Calset™ device. Discs were subjected to a simulated intrapulpal pressure (IPP) and placed inside a specially constructed incubator adjusted at 37 °C. IPT was measured before, during and after placement and curing of the resin composite using K-type thermocouple. For μTBS testing, flat occlusal middentin surfaces (n = 24) were obtained. P90 System Adhesive was applied according to manufacturer's instructions then Filtek LS was placed at the tested temperatures (n = 6). Restorative procedures were done while the specimens were connected to IPP simulation. IPP was maintained and the specimens were immersed in artificial saliva at 37 °C for 24 h before testing. Each specimen was sectioned into sticks (0.9 ± 0.01 mm^2). The sticks (24/group) were subjected to μTBS test and their modes of failure were determined using scanning electron microscope (SEM). For both preheated groups, IPT increased equally by 1.5–2 °C upon application of the composite. After light curing, IPT increased by 4–5 °C in all tested groups. Nevertheless, the IPT of the preheated groups required a longer time to return to the baseline temperature. One-way ANOVA revealed no significant difference between the μTBS values of all groups. SEM revealed predominately mixed mode of failure. Preheating of silorane-based resin composite increased the IPT but not to the critical level and had no effect on dentin μTBS.

Introduction

A category of dental composite with a resin matrix, based on ring-opening monomers, has been introduced to the market. This hydrophobic composite drives from the combination of siloxane and oxirane, thus given the name silorane. The major advantage of this restorative material is its reduced volumetric shrinkage [1,2].

* Corresponding author. Tel.: +20 2 22066203/147069439; fax: +20 2 33385 775.
E-mail address: enasmobarak@hotmail.com (E.H. Mobarak).

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Additionally, the technique of application is one of the ways to improve the success of the restorations. The high viscosity and stickiness of contemporary resin composites make the insertion, as well as adaptation, of the material to preparation walls difficult and unpredictable [3,4]. Preheating of resin based restorative materials (54 or 68 °C) prior to placement and contouring may facilitate ease of composite extrusion and enhance composite adaptation to preparation walls. Other potential benefits include increasing the degree of conversion and wear resistance [5,6].

Combination between the use of low shrinking resin composite and the modified technique of application that was achieved by preheating would be suggested to attain better adaptation [7] and bond strength. Nevertheless, preheating of resin composite was found to increase the intrapulpal temperature [6]. This may raise a concern about the adverse effects on the pulp beyond its physiological tolerable limit especially in deep cavities.

So, it would be of interest to study the effect of preheating of low shrinking resin composite on the dentin microtensile bond strength and the intrapulpal temperature changes. The null hypotheses were: (1) There is no difference in intrapulpal temperature whether silorane-based resin composite is preheated or not. (2) Dentin microtensile bond strength would not differ if silorane-based resin composite was applied at room temperature or after preheating.

Material and methods

A low shrinking silorane-based resin composite Filtek LS (Shade A_3, 3M ESPE, St Paul, MN, USA) and its corresponding adhesive system two-step self-etch adhesive system P90 System Adhesive (3M ESPE, St Paul, MN, USA) were used in this study. Table 1 shows the material brand names, compositions, manufacturers, and batch numbers.

A total of 39 sound upper human premolars; extracted from an age group of 18–20 years, were stored in phosphate buffer solution containing 0.2% sodium azide at 4 °C pending uses within 1 month [8].

Measurement of intrapulpal temperature

Preparation of specimens

Crown segments of fifteen sound human premolar teeth were cut horizontally using a slow-speed diamond saw sectioning machine (Buehler Isomet Low Speed Saw, Lake Bluff, IL, USA) under water coolant into discs of approximately 0.5 ± 0.05 mm thickness (Fig. 1A). From each crown segment two discs were obtained. A digital caliper (Mitutoyo digital caliper, Mitutoyo Corp., Kawasaki, Japan) was used to check the thickness of the discs. Dentin discs were divided into three groups (n = 10/group) according to the temperature of Filtek

Table 1 Materials-brand name, compositions, manufacturers and batch numbers.

Materials-brand name	Composition	Manufacturer	Batch no.
P90 System Adhesive Two-step self-etch adhesive system	*Primer:* Phosphorylated methacrylates, Vitrebond copolymer, Bis-GMA, water, ethanol, silane-treated silica fillers, initiators, Stabilisers. PH = 2.7 *Bond:* Hydrophobic dimethacrylate, phosphorylated methacrylate, TEGDMA, silane treated silica fillers, initiators, stabilisers	3M ESPE Dental product, St. Paul, MN, USA	N313983
Filtek LS Low Shrinking Posterior resin composite (Shade A_3)	Silorane resin, initiating system; camphorquinone, iodonium salt, electron donor. Quartz filler, yttrium fluoride, stabilisers, pigments	3M ESPE Dental product, St. Paul, MN, USA	N431331

Bis-GMA = Bis-phenol-glycidyl-methacrylate, TEGDMA = Triethylene glycol dimethacrylate.

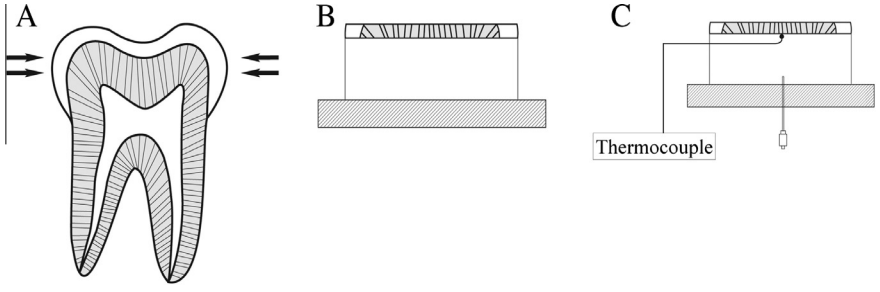

Fig. 1 Specimen preparation for intrapulpal temperature measurement; tooth sectioning to obtain dentin discs (A); dentin disc attached to the transparent tube and the Teflon plate (B); that was penetrated with a butterfly needle connected to the intrapulpal pressure assembly while the thermocouple was fixed (C).