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Case Report

Innovatively Modified Glass Bead Sterilizer for Preheating/Prewarming of Dental Composite Resins

Pooja Arora[1], Vipin Arora[2]*, Ammar Al Shammrani[3] and Mohammed Khalil Fahmi[4]

[1]Associate Professor (Prosthodontics), Department of Restorative Dental Sciences, Faculty of Dentistry, Taif University, Taif, Kingdom of Saudi Arabia

[2]Course director (Endodontics), Department of Restorative Dental Sciences, Faculty of Dentistry, Taif University, Taif, Kingdom of Saudi Arabia

[3]Dean, Faculty of Dentistry, Taif University, Taif, Kingdom of Saudi Arabia

[4]Chairman and Head, Department of Restorative Dental Sciences, Faculty of Dentistry, Taif University, Taif, Kingdom of Saudi Arabia

***Corresponding Author:** Vipin Arora, Course director (Endodontics), Department of Restorative Dental Sciences Faculty of Dentistry, Taif University, Taif, Kingdom of Saudi Arabia.

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Abstract

Prewarming/Preheating of dental composites for enhancing the degree of conversion and reducing viscosity thus improving marginal adaptation of the restoration is a well-documented technique to be followed in clinical settings. Heating the composite also dramatically decreases the curing time required for light polymerization.With the added benefit of greater depth of cure of the restorative composite, increased chemical conversion, and ease of flow for easier dispensing into the cavity preparation,pre-heating or sometimes called as pre-warming has become an indispensable technique for better dentistry.

Inspite of all these advantages, the cost and availability of device is a limiting factor in its use which can be overcome by using this simpler device commonly available in all clinics to make this technique popular and economically viable. A New, simple and innovative technique for Preheating/Prewarming of Dental Composite resins is presented.

Keywords: Preheating; Prewarming; Composite; Resin; Dental

Introduction

Despite developments in dental composite resins, some limitations compromise the longevity of dental composite restorations. The most commonly reported limitations are polymerization shrinkage,mismatch in thermal expansion, abrasion and wear resistance, toxicity, microleakage and recurrent caries [1-5].

To overcome these limitations, research has been directed to improve the mechanical properties of resins, including variations in the amount, size and type of fillers or use of non-methacrylate based monomer resins. Modified clinical procedures have been proposed by some researchers to compensate for the stress generatedfrom polymerization shrinkage and to allow better marginal adaptation between the dental composite and the walls of the cavity. Several placement techniques [6-9] have been suggested to improve the marginal seal of dental composite restorations, such as incremental placement to reduce the C factor, [10] soft-start and pulsed curing techniques to modify the reaction speed [11] and use of flowable resins to promote a better marginal adaptation [7,8]. Flowable composites, with the inherent marked fluidity, have been advocated as stress absorbers and promote adaptation [7-9,12,13]. However, because of the low filler content greater polymerization - stress is generated in comparison to filled dental composites [14-16].

Researchers have advocated that preheating or prewarmingof traditional dental resin composites can significantly improve marginal adaptation by increasing fluidity [16, 17]. In addition to this, preheating of dental composites may improve their physical and mechanical properties through a higher degree of monomer conversion, [14,18-22] which leads to a greater mechanical strength, rigidity and resistance to degradation in the oral cavity [23] Conversely, incomplete polymerization can also lead to significantly increased wear due to decreased mechanical strength and unreacted monomer units may be cytotoxic in long run, leading to potential allergic and sensitivity reactions [24-26].

Heating the composite also dramatically decreases the curing time required for light polymerization.With the added benefit of greater depth of cure of the restorative composite, increased chemical conversion, and ease of flow for easier dispensing into the cavity preparation,pre-heating or sometimes called as pre-warming has become an indispensable technique for better dentistry [27-36].

From the above-mentioned research, it is clear that the Preheating / prewarming has a significant positive effect on the Dental composite resin restorations. But Still the technique for preheating is not very much popular in developing countries and some developed countries. The main reason behind this is the lack of availability of the equipment and the cost of acquiring the equipment.

The commercially available systems available in the market are Calset (AdDent Inc, Danbury, CT, USA) and Thermaflo (vista dental, USA). The cost of such equipment's varies between 500 - 800 dollars which is at a significantly higher side in developing countries like India where dentistry is developing at a very fast pace. The cost of device can be a limitation in adopting this useful and promising technique.

To make this technique popular and economically viable, this innovation is presented wherein a glass bead sterilizer is utilised to work as a composite warmer.

Protocol for Modifications in the Equipment

In this simplified modification, we have used a glass bead sterilizer (Figure 1,2). The glass beads are replaced with common salt. The glass beads retain the heat but when it comes in contact with plastic of syringe, it sticks leading to aggregation of glass beads to the syringe. So, we replaced it with the salt. In (Figure 1) a digital thermometer is placed to show the required temperature settings.

Figure 1: Glass Bead Sterilizer with common salt and digital thermometer placed to verify temperature.

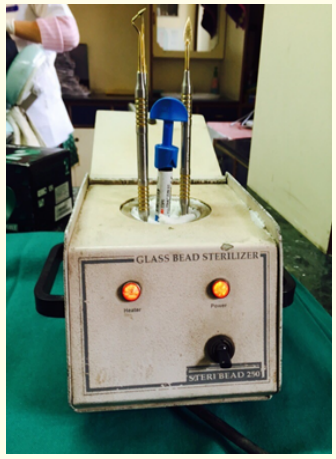

Figure 2: Glass Bead Sterilizer with common salt in which composite instruments are placed along with composite syringe.

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. A standard composite compute, a syringe tray option, or pre-loaded compute guns from different manufacturers can be directly used.

Discussion

It has been reported that, on an average, dental composites can achieve 50 - 70% conversion of resin monomers [36]. During resin polymerisation, monomeric conversion occurs when exposure to light is initiated. As the polymerization reaction progresses further, the viscosity of the dental resin composite increases with the formation and growth of polymeric chains, which inturnresult in decreased movement of molecules. The enhanced viscosity further prevents completion of polymerisations movement of the molecules in this vitrified stage becomes very limited [14,19]. On the other hand, preheated dental composites display increased monomer mobility, because of higher thermal energy, which leads to less viscosity and increased molecular motion [14,26,29,37]. Also, any delay in progression of diffusion controlled reactions will lead to increased degree of conversion. Such delay results in greater number of collisions, since free radicals are able to diffuse and react before self-deceleration occurs, which in turn enhances the degree of monomeric conversion before final verification [14,19,22,31,33]. Daronch and colleagues [18] suggested that curing time may be reduced up to 75% with prewarming of dental composites. These authors reported that light-curing of a heated-dental composite for 5 seconds led to a greater degree of conversion than light curing at room temperature for 40 seconds. In another study [19] these authors found that when composites were polymerized at 3°C, the final polymeric conversion was even less than 35%. This decreased monomer conversion at lower temperatures (when composites are kept in the refrigerator) was related to the higher viscosity of the material, which resulted in slower propagation of the reaction.

Inspite of all these advantages, the cost and availability of device is a limiting factor in its use which can be overcome by using this simpler device commonly available in all clinics. The glass bead compartment is filled with salt. The replacement of salt in our device is useful for retaining heat and it's a normally available thing. Regarding the price, it hardly costs 10 dollars which means 50 times less.

In the literature search, we found only one article by Myoung-UkJin [38] in which the author has advised using heat of the chair light for preheating. He also has described the use of hand for preheating. According to him, holding the syringe in palm of hand for 3 - 5 minutes can raise the temperature. But in our opinion, the temperature raise is not that significant to make a big change and it is unpredictable, time consuming and little bit unpractical. All other published studies describe the use of either calset or thermo flow for preheating.

The above presented device is a modification of commonly available sterilizer in the dental clinic even in the poorer nations.The affordability for this device is quite high and hardly costs 10 dollars depending on country. Nevertheless, the same unit can also be used to heat irrigate syringes and anaesthetic syringes. So, this device is a multifunctional unit which can serve multiple purposes in a dental clinic.

Conclusion

The above presented device is an innovation which is simple to use and has the potential to make pre-heating/Pre-warming technique popular among dentists in all parts of the world especially in the developing countries where cost is a significant factor in acceptance of any new technique in Dentistry.

Bibliography

1. Cramer NB., *et al.* "Recent advances and developments in composite dental restorative materials". *Journal of Dental Research* 90.4 (2011): 402-416.
2. Kubo S., *et al.* "Factors associated with the longevity of resin composite restorations". *Dental MaterialsJournal* 30.3 (2011): 374-383.
3. Puckett AD., *et al.* "Direct composite restorative materials". *Dental Clinics of North America* 51.3 (2007): 659-675.
4. Ilie N and Hickel R. "Resin composite restorative materials". *Australian Dental Journal* 56 (2011): 59-66.
5. Ferracane JL. "Current trends in dental composites". *Critical Reviews in Oral Biology and Medicine* 6.4 (1995): 302-318.
6. Lutz F., *et al.* "Quality and durability of marginal adaptation in bonded composite restorations".*Dental Materials* 7.2 (1991): 107-113.
7. Korkmaz Y., *et al.* "Effect of flowable composite lining on microleakage and internal voids in Class II composite restorations". *The Journal of Adhesive Dentistry* 9.2 (2007): 189-194.
8. Roggendorf MJ., *et al.* "Marginal quality of flowable 4-mm base vs. conventionally layered resin composite". *Journal of Dentistry* 39.10 (2011): 643-647.
9. Rueggeberg FA., *et al.* "Effect of light intensity and exposure duration on cure of resin composite". *Operative dentistry* 19.1 (1994): 26-32.
10. Carvalho RM., *et al.* "A review of polymerization contraction: the influence of stress development versus stress relief". *Operative Dentistry* 21.1 (1996): 17-24.
11. Oliveira KM., *et al.* "Shrinkage stress and degree of conversion of a dental composite submitted to different photoactivation protocols". *Acta Odontológica Latinoamericana* 25.1 (2012): 115-122.
12. Fabianelli A., *et al.* "Microleakage in class II restorations: open vs closed centripetal build-up technique". *Operative Dentistry* 35.3 (2010): 308-313.
13. Moorthy A., *et al.* "Cuspal deflection and microleakage in premolar teeth restored with bulk-fill flowable resin-based composite base materials". *Journal of Dentistry* 40.6 (2012): 500-505.

14. Deb S., *et al.* "Pre-warming of dental composites".*Dental Materials* 27.4 (2011): e51-59.

15. Oliveira LC., *et al.* "Effect of low-elastic modulus liner and base as stress-absorbing layer in composite resin restorations". *Dental Materials* 26.3 (2010): e159-169.

16. Wagner WC*., et al. "Effect of pre-heating resin composite on restoration microleakage". Operative Dentistry* 33.1 (2008): 72-78.

17. dos Santos RE., *et al.* "Effect of preheating resin composite and light-curing units on the microleakage of Class II restorations submitted to thermocycling". *Operative Dentistry* 36.1 (2011): 60-65.

18. Daronch M., *et al.* "Monomer conversion of pre-heated composite". *Journal of Dental Research* 84.7 (2005): 663-667.

19. Daronch M., *et al.* "Polymerization kinetics of pre-heated composite". *Journal of Dental Research* 85.1 (2006): 38-43.

20. Eliades GC., *et al.* "Degree of double bond conversion in light-cured composites". *Dental Materials* 3.1 (1987): 19-25.

21. Tarumi H., *et al.* "Post-irradiation polymerization of composites containing bis-GMA and TEGDMA". *Dental Materials* 15.4 (1999): 238-242.

22. El-Korashy DI. "Post-gel shrinkage strain and degree of conversion of preheated resin composite cured using different regimens". *Operative Dentistry* 35.2 (2010): 172-179.

23. Muñoz CA., *et al.* "Effect of pre-heating on depth of cure and surface hardness of light-polymerized resin composites". *American Journal of Dentistry* 21.4 (2008): 215-222.

24. Ausiello P., *et al.* "Cytotoxicity of dental resin composites: an *in vitro* evaluation". *Journal of Applied Toxicology* 36.6 (2013): 451-457.

25. Yan YL., *et al.* "Changes in degree of conversion and microhardness of dental resin cements". *OperativeDentistry* 35.2 (2010): 203-210.

26. Froes-Salgado NR., *et al.* "Composite pre-heating: effects on marginal adaptation, degree of conversion and mechanical properties". *Dental Materials* 26.9 (2010): 908-914.

27. Ciccone-Nogueira JC., *et al.* "Microhardness of composite resins at different depths varying the post-irradiation time". *Journal of Applied Oral Science* 15.4 (2007): 305-309.

28. Tantbirojn D., *et al.* "Hardness and postgel shrinkage of preheated composites". *Quintessence International* 42.3 (2011): e51-59.

29. Lucey S., *et al.* "Effect of pre-heating on the viscosity and microhardness of a resin composite". *Journal of Oral Rehabilitation* 37.4 (2010): 278-282.

30. Awliya WY. "The influence of temperature on the efficacy of polymerization of composite resin". The *Journal of Contemporary Dental Practice* 8.6 (2007): 9-16.

31. Calheiros FC., *et al.* "Influence of radiant exposure on contraction stress, degree of conversion and mechanical properties of resin composites". *Dental Materials* 22.9 (2006): 799-803.

32. Calheiros FC., *et al.* "Degree of conversion and mechanical properties of a BisGMA:TEGDMA composite as a function of the applied radiant exposure". *Journal of Biomedical Materials Research Part B: AppliedBiomaterials* 84.2 (2008): 503-509.

33. Lohbauer U., *et al.* "The effect of resin composite pre-heating on monomer conversion and polymerization shrinkage". *Dental Materials* 25.4 (2009): 514-519.

34. Dewaele M., *et al.* "Volume contraction in photocured dental resins: the shrinkage-conversion relationship revisited". *Dental Materials* 22.4 (2006): 359-365.

35. Schneider LF., *et al.* "Effect of time and polymerization cycle on the degree of conversion of a resin composite". *Operative Dentistry* 31.4 (2006): 489-495.

36. Cook WD., *et al.* "Resin-based restorative materials-a review". *Australian Dental Journal* 29.5 (1984): 291-295.

37. Sabatini C., *et al.* "Effect of preheated composites and flowable liners on Class II gingival margin gap formation". *Operative Dentistry* 35.6 (2010): 663-671.

38. Myoung-UkJin. "Prepare the pre-heated composite resin". *Restorative Dentistry and Endodontics* 38.2 (2013): 103-104.

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