Composite Preheating: A Review Article

Review Article

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Abstract

The aim of this study is to evaluate the effect of preheating on composite resins' mechanical and physical properties. Preheating of composite resins positively affects the degree of conversion, viscosity, microleakage, marginal adaptation, microhardness and color change however, the flexural strength is adversely affected.

Key words:
•Preheating •Composite Resins •Flexural Strength

Intoduction

Nowadays composite resins are highly recommended as restorative materials due to underwhelming mechanical and aesthetic properties and as a mercury-free alternative material to amalgam. (1)

Polymerization shrinkage, postoperative sensitivity, inadequate proximal contact, poor wear resistance and lack of proper adaptation in some clinical conditions are composite resins' drawbacks. (2) Preheating was first introduced by Friedman in 2001. (3) Increment of restoration durability and stress relief (2,4), better adaptation (5) and shortening of curing time (6) are the benefits of preheating used to improve mechanical properties of composite resins.

However, Daronch et al. reported no significant difference between the preheated composite resins and composite resins. (7) Decreasing shelf life and requiring quick work are the drawbacks of composite preheating. (8) Also, pulp compatibility is of concern when composite resins are preheated to 54-68°C.

Nevertheless, studies have found that pulp temperature is raised only by 0.8°C after placement of a 60°C preheated composite resin while 20s of light curing increases pulp temperature by 5°C.(9) Daronch et al. found that after removing composites from heating device, 50% of the temperature attained will be lost after 2 minutes and almost 90% will be lost after 5 minutes. (7)

Microleakage and preheating:

Poor marginal adaptation and composite shrinkage causes micro leakage and consequently, results in recurrent caries, food retention and even restoration failure. (10) There were attempts to improve adaptation and to limit shrinkage of composite resins.

At first, the researchers added filler to resin composites to improve the adaptation. (10) Yet, increasing the filler load resulted in higher viscosity which led to concerns about handling of the resin composite material and could leave behind unwanted void (11)

A variety of studies have shown that lower viscosity composites can improve adaptation and reduce microleakage. (12-15) In this regard, researchers introduced flowable composites by decreasing the filler load. (11) However, the flowable composites were not as durable and resistant as higher viscosity resin composites which restricted their application in restoration of posterior teeth. (11-16)

Preheating resin composite was an approach to mimic flowable composites in achieving better adaptability by reducing viscosity, without losing its mechanical properties. (10) The findings of Holmes et al., Broome et al., Blalock et al., Wanger et al., Salgado et al. and Yang et al. support the benefits of preheating in decreasing microleakage of resin composite restorations. (3,9,15,17-19) Preheating of resin composites, besides decreasing microleakage by increasing flowability and adaptation, leads to a more homogeneous polymerization and subsequently to a more homogeneous shrinkage and reduces the micro leakage. (20)

Preheating and mechanical properties:

Degree of conversion is defined as the ratio of the remaining C=C double bonds in a cured resin composite to the total number of C=C bonds in the uncured material. (8-9) Degree of conversion is a parameter to determine final mechanical properties of restorative materials. (9) In other words, a lower degree of conversion decreases composite resins' microhardness, wear resistance, fracture resistance and flexural strength. (9-11)

Studies suggest preheating of composite resins as a method to enhance degree of conversion and subsequently, to enhance microhardness, wear resistance and fracture resistance, by increasing temperature. (12,14-18) Increment of temperature leads to further mobility of monomers and better cross-linked polymerized networks. (1,9) The idea of improving mechanical properties of resin composites by preheating is confirmed by Torres et al., Kashi et al., Eman et al. and Lucy et al. (21-24). On the contrary, Didron et al (20) found that preheating to have no significant effect on microhardness. Degree of conversion may vary based on the brand and the shade of the composite resin which explain the different findings of above-mentioned studies. (3)

Flexural strength is a critical parameter for brittle materials and is correlated to the degree of conversion. (3-6) Although, preheating of composite resins increases degree of conversion, it has no significant effect on flexural strength.(3)

Salgado et al, Nada et al. and Uctasli et al. no significant difference in flexural strength between preheated and non-heated composites. (3,25,26) Even, Amario et al, reported that highly repeated cycles of preheating may have negative effects on the flexural strength of resin composites. (27)

Color stability:

According to Micali and Basting residual monomers in the polymeric chain can form colorimetric degradation products. (28) On the other side, non-converted double carbon link can increase the penetration of solvent from oral cavity and hydrolyze the silane around filler which creates microcracks and make the resin composite more susceptible to discoloration. (29) Also, microleakage leads to penetration of extrinsic staining into the restoration. (19,30-31) As previously discussed, preheating composite can lead to better color stability by increasing degree of conversion and marginal adaptation which decrease residual monomers, non-converted double carbon link and microleakage, consequently.

This claim is verified by Tomaselli et al., Mundim et al. and Kahnamouei et al..(32-34)

Conclusion

It is concluded that preheating of composite resins positively affects the degree of conversion, viscosity, microleakage, marginal adaptation, microhardness and color change however, the flexural strength is adversely affected.

However, in order to assess the clinical significance of pre-heating, further studies with larger sample size and analogous experimental conditions are required.

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