ARC Journal of Dental Science
Volume 1, Issue 2, 2016, PP 1-3
ISSN No. (Online): 2456-0030
http://dx.doi.org/10.20431/2456-0030.0102001
www.arcjournals.org

Bulk Fill Composite Resins. A Novelty in Resin-Based Restorative Materials

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Abstract: *Composites resins are the most popular restorative materials providing very good esthetics and long period of good clinical performance. Depth of cure of composite resins is crucial in determining the maximal increment thickness when restoring tooth cavities. In restorations with conventional composite resins the thickness of each increment has been defined as up to 2 mm. Bulk fill composite resins are assumed to be curable to a thickness of 4-5 mm, develop lower polymerization shrinkage stresses and present higher light transmission properties due to reduction of light scattering at the filler–matrix interface by either decreasing the filler amount or increasing the filler size. Further studies especially in vivo are necessary to verify the improved clinical performance of bulk fill composite resins.*

EDITORIAL

Composites resins are the most popular restorative materials providing very good esthetics and long period of good clinical performance. Depth of cure of composite resins is crucial in determining the maximal increment thickness when restoring tooth cavities. In restorations with conventional composite resins the thickness of each increment has been defined as up to 2 mm [1]. This limitation is related to the degree of monomer conversion of composite materials, which determines their mechanical and physical properties such as strength, modulus, hardness and solubility [2], as well as their biocompatibility [3]. Although the critical threshold for the degree of conversion of dental composite materials has not yet been established, it has been accepted that the degree of monomer conversion below 55% is not appropriate for clinical performance [4].

There are many parameters that affect depth of cure of composite resins. These contain composition (monomers, inorganic fillers, photoinitiators, coupling agents) [5-7], shade and translucency [8] of the composite resin and characteristics of the light-curing unit (LCU) such as light intensity, thermal emission, wave length range, diameter of the tip and curing mode [9]. Other factors such as exposure time [10] and distance of the restorative from the tip of the LCU [11] may also affect depth of cure of composite materials.

As it mentioned before, composite resins should be applied to the cavity only in increments up to 2 mm thick to ensure appropriate light transmittance and adequate degree of polymerization[1]. Nevertheless, incremental technique for composite restorations is associated with various weaknesses including the risk of incorporating air bubbles or contaminations between composite layers, failures in bonding between the increments and an extended treatment time [12].

Aiming to overcome these disadvantages and simplify the time-consuming incremental technique of composite restorations, a new category of composite restorative materials has been introduced the so-called "bulk fill" composite resins. Bulk fill composite resins are assumed to be curable to a thickness of 4-5 mm [13], develop lower polymerization shrinkage stresses [14] and present higher light transmission properties due to reduction of light scattering at the filler–matrix interface by either decreasing the filler amount [5] or increasing the filler size [15]. To achieve this extended depth of cure bulk fill composite resins have acquired certain modifications in their composition in order to increase penetration of visible light through the materials such as increased filler size [15] and novel photoinitiators [16].

It has been reported that a reduction in intermolecular distance from 0.3-0.4 nm to 0.15 nm may occur during polymerization of composite resins [17] generating stresses due to the contraction of the

material, which may lead to bonding failure and increase in microleakage of the restoration. Previous studies have reported that bulk fill composite resins may present better polymerization shrinkage stress kinetics [18] and decreased cuspal deflection [19] than conventional composite resins. However, the improved behavior of these newly introduced composite restoratives concerning marginal adaptation to cavity walls remains unconfirmed [19].

Bulk fill composite resins are further classified into high-viscosity and low-viscosity (flowable) materials. High-viscosity bulk fill composites include greater amounts of filler particles compared to low-viscosity bulk fill composites. As a result, the flowable composite resins exhibit better adaptation on the cavity walls but present greater polymerization shrinkage and lower mechanical properties. Due to their lower mechanical properties their restorations is recommended to be finished with a 2-mm capping layer of a high-viscosity bulk fill composite resin, especially when restoring areas which are submitted to occlusal stresses [20].

It has been demonstrated that preheated composite resins show reduced viscosity [21] and increased polymerization efficiency [22]. Heating composite resins prior to placement in the cavity and immediately light-curing increases monomer conversion rate and thus the duration of the irradiation period may be decreased [22]. With increased paste temperature, free radicals and developing polymer chains become more fluid as a result of reduced paste viscosity and they react to a greater extent, leading to a more complete polymerization reaction and enhanced cross-linking [23]. The increase in the degree of polymerization of composite resins may lead to better internal adaptation to cavity walls [24], improved mechanical properties and increased wear resistance [22]. In a recent study [25] it has been demonstrated that pre-heating significantly reduces shrinkage force formation of high-viscosity bulk-fill and conventional composite resins, while maintaining or increasing the degree of monomer conversion, dependent upon the specific composite material used.

In conclusion, bulk fill composite materials may be very useful for restorations of posterior teeth mainly due to their advantages in application technique and polymerization shrinkage. However, further studies especially *in vivo* are necessary to verify the improved clinical performance of bulk fill composite resins.

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