Bond Strength of Different Resin Composites to Various Resin-Based Lining Materials

Thesis

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

(قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا
إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ)

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Resin composites are direct restorative tooth-colored materials that frequently used for aesthetic purposes in daily practice [1]. It has been reported that resin composites suffer from polymerization shrinkage, which remains a major drawback and a problem for their clinical durability as dental restorative materials [2]. The placement of resin composites requires several clinical steps to achieve best results, into which researchers and manufacturers continuously search for modifications. These modifications were focused on either to reduce clinical application steps, technique sensitivity or to overcome polymerization shrinkage of resin composite materials [3, 4].

In an effort to overcome some of the concerns associated with the traditional resin composite materials, high viscous flowable composites, fiber reinforced composites or ormocer were launched in the market in an attempt to shorten clinical application time, favor stress distribution at resin/tooth interface or reduce polymerization shrinkage as well as water sorption respectively [5-7]. By fusing nano-hybrid organic particles with ormocer technology that patent by VOCO Company, a new ormocer material was launched in the marked in 2015 under the name “Admira Fusion”. The manufacturer claims that, by this new technology, the decrease in water sorption, the reduction of polymerization shrinkage percentage and the improvement of its biocompatibility became advantages over traditional resin composites [8].

New generation of packable or flowable resin composites, known as ‘bulk-fill’ composites, has been developed that allowed clinicians to light cure this material up to 4mm thick layer [9, 10].

One of the materials in this category is the fiber reinforced composite. The manufacturer of this product “GC incorporation” claims that in addition to it is a “bulk fill” one, the presence of fibers enhanced its bonding with the overlying resin composite [11].

The use of underlying resin-based materials under resin composites have been found to be of great interest [12]. Nevertheless, continuous work has been reported in an attempt to improve the bonding between these underlying materials and the overlying resin composites. In a way to achieve these optimum properties of the layering technique, there should be a good and reasonable bond between the two materials being layered over each other [13-15]. Therefore, the bond strength between the two materials plays an important role for success of the restoration as a single restoration. If this could be achieved, the durability of layered restoration could be predictably increased [16].

In order to simplify the application procedures and reducing the clinical application time, bonding between underlying and overlying materials should be achieved without the use of any additional surface treatments or the application of intermediate adhesive layer. Accordingly, testing the bond strength between these two resin-based materials without any additional surface treatment or the application of intermediate adhesives might be of value.

Resin composite materials became the first choice used in direct anterior and posterior restorations owing to their satisfactory esthetic quality results, conservation of tooth structure, reparability and reasonable cost compared to indirect restorations. Despite the major developments in resin-based restorative materials, they all show a certain degree of volume reduction due to their contraction during polymerization [17, 18]. Polymerization of dimethacrylate-based composites is always accompanied by substantial volumetric shrinkage about 1% to 3% in packable composites and up to 6% in flowable composites [19].

Polymerization contraction is time-dependent and proceeds in two stages pre-gelation and post-gelation [20]. During that initial phase of polymerization (pre-gel phase), in which the newly formed polymer is still in a flexible state, the internal stress arising from shrinkage can be relieved by flow of the composite, reducing the stress at the tooth/resin interface [21]. After gelation, the elastic modulus starts to increase as the polymer is transformed from a viscous-plastic phase with flow into a rigid-elastic phase [22, 23]. In post-gel phase, flow ceases, resin composite no longer tends to deform and cannot consequently compensate for shrinkage stresses [24]. Therefore, post-gel polymerization results in clinically relevant stresses in resin composite-tooth interface and the surrounding tooth structure [25].

Shrinkage develops during polymerization due to a reduction in distance between monomer molecules as a result of formation covalent bonds, which reduces the free volume within the monomer structure producing packed polymeric molecule [26, 27]. Hence, high contraction stresses are created within the restoration by pulling it from the tooth surface causing marginal leakage, which results in margin discoloration, recurrent