Assessment of color stability of different resin cements having different modes of polymerization before and after aging

Thesis

Submitted for Fulfillment of the Requirements of the Master Degree in Crown and Bridge, Faculty of Dentistry, Ain Shams University

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BD.Sc (Ain Shams University 2010)

Faculty of Dentistry
Ain Shams University
2015

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Acknowledgment

I would like to sincerely thank Dr. Tarek Salah Morsi, Assistant Professor at Crown and Bridge department, Faculty of Dentistry, Ain Shams University, for his guidance, understanding, and patience in finding an appropriate subject in the beginning of the process of writing the thesis. His mentorship was a paramount in providing a well rounded experience consistent my long-term career goals. His valuable advice, unique cooperation, will always be deeply remembered. This work would have never been completed without his assistance and sincere guidance.

I would also like to thank Dr. Ahmed Ezzat Sabet, Lecturer at Crown and Bridge Department, Faculty of Dentistry, Ain Shams University for his assistance, good advice, and most importantly his friendship on both the academic and personal level. His supervision and remarkable effort are highly appreciated.

Dedication

This work is dedicated to:

My dear parents

And

My beloved wife

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Introduction:

Porcelain veneers have become an interesting treatment option for patients seeking better esthetics in the anterior region[1]. Patients prefer these restorations because they require minimally invasive preparation of the tooth structure compared with other treatment options [2].

The biocompatibility and translucency of porcelain materials guarantee not only healthy margins but also superior esthetics [3]. The final color of a ceramic restoration could be influenced by translucency, opalescence, fluorescence, surface texture and shape properties, porcelain brand and batches, the number of porcelain firings, and the condensation technique, and also by the color, translucency, and thickness of the underlying resin luting agent [4-6].

Besides all these esthetic considerations, the success of a ceramic restoration depends primarily on the durability of the bond between the ceramic and luting agent, as well as that between the luting agent and tooth structure [7].

Resin luting cements, considered as active-type cements, have increasing applications in the cementation of fixed prostheses, since they exhibit enhanced mechanical, physical, and adhesive properties compared with those of other conventional luting agents [8]. Further, they provide adequate color stability and increased fracture resistance of overlying ceramic restorations, together with an optimal esthetic result. Presently, resin luting cements are supplied in different shades to enhance final color match and to allow clinicians to select the proper cement shade for ceramic veneers to obtain desirable esthetics.

However, the impact of cement shades on the final color of ceramic restorations remains controversial; some investigations have verified that resin cements can produce perceptible color differences with particular combinations of background shades, cements, and ceramic restorations [9, 10]. Other studies identified that resin cements presented no significant effects on the final color of IPS Empress all-ceramic material [11-13].

However, the thickness of restorative materials plays a crucial role in the final color of restorations. Resin cements are the luting agent of choice for the cementation of tooth-colored restorations, including both porcelain and indirect resin composite [14], much of the initial esthetic success of dental restorations depends on a good color match between the tooth and the restorative material. Where the stability of that color match is important for the long-term esthetic success of a restoration. The color stability of both porcelain and luting materials is important for the esthetics of laminate veneers [15].

One feature that is fairly consistent among various resin cements is the ability to use the material as a light-activated resin only or to mix with a chemical accelerator, making the resin both photo-initiated and dual-polymerized [16].

Research has shown that to obtain more complete polymerization under a restoration 2 mm or more thick, a dual-polymerized resin is necessary [17 18]. It has also been shown that opacity of the porcelain restoration does not affect polymerization as much as the thickness of the porcelain [19-21] , Another study has shown that the color of porcelain has an effect on the hardness of the underlying resin luting agent [22], Therefore, in most bonding situations, it is preferable to use a dual-polymerized resin cement to insure an adequate bond [16].The dual-polymerized reaction is initiated with a peroxide initiator and an amine accelerator [18], For photo initiation to occur, visible light in the range of 460 nm (blue) is necessary to activate the camphoroquinone initiator [19] . The additional chemicals necessary for dual-polymerization can cause the color of the cement to change over time, although little research has been completed on this topic. Color match with the surrounding teeth is vitally important to the success of anterior restorations [16].

Researchers have found that with accelerated aging the color of dual-polymerized cements is somewhat unstable [15].

A recent study has shown detectable color differences in the try-in paste and the auto polymerized and light-activated components of a resin-cement system [8]. Also, chemically cured resin composites, visible light–cured resin composites, and glass-ionomer cements have all exhibited tendencies to color shifts over extended periods in both clinical and in vitro studies [7,9–11].Therefore, most practitioners still use light-polymerized resin cements for the luting of porcelain veneers and other esthetic restorations for anterior teeth [16].

The purpose of this study was to measure the color stability of both the light- and dual-polymerized versions of one shade of three commercial resin cements following accelerated aging [16].

Review of literature:

Resin cements are essentially flowable composites of low viscosity, with filler distribution and initiator content adjusted to allow for a low film thickness and suitable working and setting times [(22)].

The resin cements are the newest type of cements for indirect restorations, and they have the ability to bond to the tooth structure and the internal surface of the restoration[(23)], it is chiefly used as a luting agent for all kinds of fabricated restorations (Metal, all ceramic, resin and temporary restorations).The adhesion mechanism of earlier resin cements was mostly micromechanical, but newer cements especially those containing self-etch primers and acidic monomers have been shown to bond chemically to the tooth structure and restoration as well [(23)].Because of their high bond strengths to the tooth structure, the resin cements provide more retention than conventional luting cements. However, they require multiple steps, are difficult to clean up, and are more technique sensitive than conventional cements [(23)].

Simon and Darnell et al. [(24)] **in (2012)** illustrated that resin cements are composed of the same basic component as the composite restorative material but with lower concentration of filler particles. These cements have higher compressive, flexural, and tensile strength than the conventional cements and can be used for almost any type of restoration and restoration material. These cements however are more complex than the conventional cements and are highly technique sensitive.

To maximize the properties of resin cements, a clear understanding of the factors that affect its clinical performance is of paramount importance. These factors are interrelated. The most important factor affecting the success of resin cements is the bond strength of the resin cement. Bond strength in turn is affected by pretreatment procedures, the depth of cure and degree of polymerization of the resin cement, and incompatibilities between the adhesive resin and the resin cement [(23)].

Factors that may affect polymerization include cement film thickness, opacity, and translucency of both the cement and restoration and shade of the restoration, properly cured resin cement will exhibit high compressive and flexural strengths, properties that enhance bond strength. Properly cured resin cements are also virtually insoluble to oral fluids. The mode of delivery and method of mixing the resin cement are also factors that may affect the overall clinical performance of the resin cement [(23)].

Composition and Chemistry of resin cements

The composition of most current resin cements is similar to that of resin-based composite filling materials: a resin matrix with silane-treated inorganic fillers [25].

There are four structural components in dental resin cements:

1. **Resin Matrix:**

   A plastic resin material that forms a continuous phase and binds the filler particles. Most dental composites and resin cements use a blend of aromatic and/or aliphatic dimethaclylate monomers such as:

   1) Bisphenol -A glycidyl dimethacrylate(bis-GMA).
   2) Urethane dimethacrylate (UDMA).
   3) ethoxylated Bis-GMA(Bis-EMA) [22].

   and are combined with smaller molecules usually derived from ethylene glycol dimethacryles (DEGDMA)and triethylene glycol dimethacrylate (TEGDMA) to achieve a high degree of conversion with a relatively low volumetric shrinkage[22].

   For self adhesive resin cements; the adhesive monomer incorporated in the bonding agent and the resin cement includes:

   - 4-META which is a liquid adhesive that acquires a cement consistency by incorporating polymer beads.
   - An organophosphate, such as 10-methacryloyloxydecamethylene phosphoric acid (MDP), a polymerizable phosphoric acid ester, with Bis-GMA [22].