journal of dentistry 41s (2013) e53–e61

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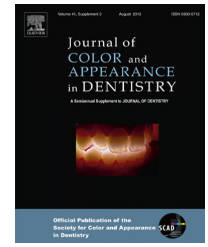

Effect of one-step polishing system on the color stability of nanocomposites

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ARTICLE INFO

Article history:
Received 9 April 2012
Received in revised form
24 September 2012
Accepted 8 October 2012

Keywords:
Nanocomposite resin
Color stability
Polishing

ABSTRACT

Objectives: This study was to compare the effect of three different one-step polishing systems on the color stability of three different types of nanocomposites after immersion in coffee for one day and seven days and determine which nanocomposite material has the best color stability following polishing with each of the one-step polishing system.

Methods: The nanocomposites tested were Tetric EvoCeram, Grandio and Herculite Précis. A total of 120 discs (40/nanocomposite, 8 mm × 2 mm) were fabricated. Ten specimens for each nanocomposite cured under Mylar strips served as the control. The other specimens were polished with OptraPol, OneGloss and Occlubrush immersed in coffee (Nescafé) up to seven days. Color measurements were made with a spectrophotometer at baseline and after one and seven days. Two way repeated measure ANOVA, two way ANOVA and Bonferroni tests were used for statistical analyses ($P < 0.05$).

Results: The immersion time was a significant factor in the discoloration of the nanocomposites. The effect of three one-step polishing systems on the color stability was also significant. The color change values of the materials cured against Mylar strips were the greatest. The lowest mean color change values were from the Occlubrush polished groups. The effect of the three different types of nanocomposite on the color change was significant. The highest color change values were with Tetric EvoCeram groups. The lowest color change values were with Herculite Précis groups.

Conclusion: The color change of nanocomposite resins is affected by the type of composite, polishing procedure and the period of immersion in the staining agent.

1. Introduction

Increasing demand for aesthetic dentistry has been coupled with rapid rate of development of new aesthetic restorative materials.[1] The composite resin has the advantage of tooth-like appearance; so it is used to replace missing tooth structure and modify tooth color and contour, thus enhancing facial aesthetic.[2] Thus the clinical use of composite resins has increased over the past few years due to increased aesthetic demand by patients, improvements in formulation and simplification of bonding procedures.[3] Dental composites are commercially classified by the filler particle size: macrofilled 8–12 μm (1960s), microfilled 0.04–0.4 μm (1970s), packable (1990s), flowable 0.6–1.0 μm (1990s) composite resin and nanocomposites (2000s): nanofill 0.005–0.01 μm and nanohybride 0.015–0.05 μm.[2]

Development and advances in the field of nanotechnology have affected dentistry in several ways. Various new composites based on nanoparticle filler technology have been developed.[4] The nanocomposites have many advantages including increased mechanical properties, improved optical

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0300-5712/$ – see front matter
http://dx.doi.org/10.1016/j.jdent.2012.10.008

characteristics, better polish retention than the hybrids and microhybrids of conventional composites and increased wear resistance.[5]

One of the most important factors in aesthetic restoration is a smooth surface finish. Irregular composite surfaces associated with improper finishing and polishing may create clinical problems such as mechanical retention for plaque, gingival irritation, discoloration, recurrent caries[6] and poor or suboptimal aesthetics of the restored teeth.[7] A smooth surface adds to the patient's comfort as a change in surface roughness of 0.3 μm can be detected by the tip of the tongue.[8] Early studies had shown that the smoothest surface of a restoration was produced when the resin was polymerized against a Mylar matrix strip.[9,10] However, despite careful placement of the matrix, removing excess material and recontouring of the restoration was often necessary.[11] Although the surface obtained with a Mylar strip is perfectly smooth, it is rich in resin organic binder; therefore, removal of the outer most resin by finishing and polishing will produce a harder, more wear resistant and more aesthetically stable surface.[12] Various finishing and polishing devices had been used in the past to finish the tooth colored restorative materials which included – fluted carbide burs, diamond burs, stones, abrasive discs and strips, polishing pastes, rubber cups and abrasive wheels.

Most traditional polishing systems required the use of two or even more polishers.[13] More recently, diamond polisher and silicone synthetic rubbers have been introduced to give a high surface quality and reduce the steps and clinical time spent to finish a restoration. These are known as one-step polishing systems.[14] Proper color match of a dental restoration with adjacent teeth is important not only at the initial stage of the restoration but also over a longer period of time.[15] Staining or discoloration is one of the primary reasons for replacement of composite restorations. Discoloration of composites may be caused by intrinsic and extrinsic factors. Intrinsic factors involve the discoloration of resin material itself and the interface of matrix and filler and oxidation or hydrolysis in the resin matrix.[15] Extrinsic factors include staining by absorption of colorants as a result of contamination from exogenous sources and can vary according to the oral hygiene, eating, drinking and smoking habits.[16] The objectives of this study are to: (1) Compare the effect of three different one-step polishing systems on the color stability of three different types of nanocomposites after immersion in coffee. (2) Determine which nanocomposite material has the best color stability following polishing with each of the one-step polishing system after immersion in coffee. (3) Evaluate the effect of composite resins and polishing systems on color stability and their interactions. The null hypothesis is that there will be no difference in the color stability among all three types of nanocomposites polished using one-step polishing systems.

2. Materials and methods

Forty specimens measuring 8 mm diameter and 2 mm in thickness were made from each composite resin listed in Table 1 to form three experimental groups. The composite was injected directly into five split steel cylindrical moulds measuring 8 mm in diameter and 2 mm thickness (Fig. 1) which were fixed on a perspex holder with a Mylar strip placed between moulds and holder. The composite was injected and lightly condensed into each mould using a plastic instrument. The upper surface of the mould was covered with a Mylar strip and a microscope glass slide. Finger pressure was applied on the glass slide to remove excess material, obtain a flat surface and protect the composite resin from oxygen inhibition. The composite resin was cured through the glass slide and Mylar strip for 40 s with a visible light curing unit (Optilux 501, 8 mm turbo curved light, Kerr Corporation, CA, USA). The metal mould was reversed and the glass slide was placed on it to cure the composite resin from the other side of the mould. The end of the light guide was in contact with the microscope glass slide during curing to standardize the distance between the light source and the specimen. The curing light intensity was monitored using the built-in curing radiometer at 650 mW/cm^2.

Forty specimens of each composite resin were numbered on the bottom using a high speed small round bur and divided randomly into four subgroups; each contained 10 specimens according to the different surface polishing procedures. Ten specimens of each subgroup received no polishing treatment

Table 1 – Composition and manufacturer of the nanocomposite resin materials used in this study.

Composite resins	Composition	Type Shade	Filler content	Manufacturer
Grandio	Matrix: Bis-GMA, dimethacrylate, urethanedimethaacrylate (UDMA), triethylene glycol dimethacrylate (TEGDMA). Filler: silicium dioxide nanofillers (20–50 nm), glass ceramic microfillers (1 μm)	Nanohybrid A2	87% (w/w) 71.4% (v/v)	Voco, Cuxhaven, Germany
Tetric EvoCeram	Matrix: Bis-GMA, urethane dimethacrylate, ethoxylated Bis-EMA, additives, catalysts, stabilizers, pigments. Filler: (0.5 μm) barium glass, ytterbium trifluoride, mixed oxide, prepolymer	Nanohybrid A2	82.5% (w/w) 68% (v/v)	Ivoclar Vivadent, Schaan, Liechtenstein
Herculite Précis	Matrix: Bis-GMA, TEGDMA Filler: three fillers – prepolymerized filler (PPF), silica nanofiller (50 nm) and submicron hybrid filler (barium glass filler of 0.4 μm)	Nanohybrid A2	78%	Kerr Corporation Collins Ave., Orange, USA