JOURNAL OF DENTISTRY 39S (2011) e9–e17

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Comparison of different finishing/polishing systems on surface roughness and gloss of resin composites

Sibel A. Antonson [a,*], *A. Rüya Yazici* [b,1], *Evren Kilinc* [c,2], *Donald E. Antonson* [a,3], *Patrick C. Hardigan* [d,4]

[a] *Department of Restorative Dentistry, University at Buffalo, State University of New York, School of Dental Medicine, Buffalo, NY, USA*
[b] *Hacettepe University, School of Dentistry, Department of Conservative, Dentistry, Ankara, Turkey*
[c] *Department of Cariology and Restorative Dentistry, Nova Southeastern University, School of Dental Medicine, Fort Lauderdale, FL, USA*
[d] *Nova Southeastern University, Health Professions Division, Fort Lauderdale, FL, USA*

A R T I C L E I N F O

Article history:
Received 20 November 2010
Received in revised form
18 December 2010
Accepted 6 January 2011

Keywords:
Finishing/polishing systems
Roughness
Gloss
Resin composites

A B S T R A C T

Objectives: The aim of this study was to compare four finishing/polishing systems (F/P) on surface roughness and gloss of different resin composites.
Methods: A total of 40 disc samples (15 mm × 3 mm) were prepared from a nanofill – Filtek Supreme Plus (FS) and a micro-hybrid resin composite – Esthet-X (EX). Following 24 h storage in 37 °C water, the top surfaces of each sample were roughened using 120-grit sandpaper. Baseline measurements of surface roughness (Ra, μm) and gloss were recorded. Each composite group was divided into four F/P disk groups: Astropol[AP], Enhance/PoGo[EP], Sof-Lex[SL], and an experimental disk system, EXL-695[EXL] ($n = 5$). The same operator finished/polished all samples. One sample from each group was evaluated under SEM. Another blinded-operator conducted postoperative measurements. Results were analysed by two-way ANOVA, two interactive MANOVA and Tukey's *t*-test ($p < 0.05$).
Results: In surface roughness, the baseline of two composites differed significantly from each other whereas postoperatively there was no significance. The Sof-Lex F/P system provided the smoothest surface although there were no statistical significance differences between F/P systems ($p > 0.01$). In gloss, FS composite with the EXL-695 system provided a significantly higher gloss ($p < 0.01$). EX treated by Soflex revealed the least gloss ($p < 0.05$). SEM images revealed comparable results for F/P systems but EX surfaces included more air pockets.
Conclusions: Four different finishing/polishing systems provided comparable surface smoothness for both composites, whereas EXL with FS provided significantly higher gloss. SEM evaluations revealed that the EX surface contained more air pockets but F/P systems were compatible.

* *Corresponding author*. Tel.: +1 716 829 2862.
E-mail addresses: sibela@buffalo.edu (S.A. Antonson), ruyay@hacettepe.edu.tr (A.R. Yazici), kilinc@nova.edu (E. Kilinc), antonson@buffalo.edu (D.E. Antonson), patrick@nova.edu (P.C. Hardigan).
[1] Tel: +90 312 305 2270.
[2] Tel.: +1 954 262 1912.
[3] Tel.: +1 716 829 2862.
[4] Tel.: +1 964 678 2273.
0300-5712/$ – see front matter
doi:10.1016/j.jdent.2011.01.006

1. Introduction

In restorative dentistry, one of the main goals is to increase the lifetime of dental restorations. Many clinicians prefer to use resin composites in the posterior region because of the growing demand for more esthetic treatments by patients. The clinical success of resin composites is related to the appearance and surface smoothness, however the replacement frequency of tooth-colored restorations is mostly because of secondary caries and discoloration.[1–3] It is essential to obtain adequate smoothness and gloss for a successful resin composite restoration. Moreover, there should also be a healthy relationship between the restoration and the adjacent dental tissues. The inadequate finishing/polishing of resin composites leads to increased plaque retention, gingival inflammation, discoloration and also leads to patient discomfort.[4–8] Jones et al.[9] reported that a surface roughness of 0.3 μm can be detected by the tip of the patient's tongue. Proper contour, smoothness and high gloss can produce the desired appearance of natural tooth structure desired by patients.[10] A rougher surface texture can lead to decreased gloss and increased discoloration of the material surface which can affect the restorations' esthetics.[11–13] Therefore, it is of paramount importance to obtain smooth and glossy surfaces. Variables, such as resin composite type, resin monomer, concentration and type of filler particles, the finishing/polishing system used, all influence the final surface polish of resin composites.[14–18]

The use of nanotechnology in new resin composite formulations is one of the most promising contributions to dental materials. Nanofill composites are formulated with both nanomer and nanocluster filler particles.[19] They offer high translucency, high polish and superior gloss as well as adequate mechanical properties suitable for high stress-bearing restorations.[19–22] Dresch et al.[22] compared the clinical performance of a nanofill resin composite, Filtek Supreme, for posterior restorations with 2 microhybrid and 1 packable composites. They reported that the nanofill resin composite showed similar performance to the other packable and microhybrid resin composites.

In general, three different steps are used in order to finalize restorations; contouring, finishing and polishing. Typically, burs and/or coarse sand paper based systems are used for bulk reduction and contouring of the newly placed restorative materials. Finishing removes the scratches created by the contouring instruments, and provides a smooth surface. Polishing, the final step, provides an enamel-like luster to the restoration as well as reduces the surface energy of the restoration.[23] A wide variety of finishing and polishing systems with dissimilar compositions, abrasives and shapes are commercially available. Their effects might differ among the resin composites and also there might be variations between the systems which could impact the final surface texture. When different techniques are proposed, not only their efficiency in maintaining smooth surface but also their ability to obtain a gloss surface have to be considered. It is known that gloss measurement is an additional parameter to roughness while evaluating the effectiveness of polishing.[24,25] However, there is a lack of consensus as to which technique provides the smoothest and glossiest surface for resin composites.

The aim of this study was to evaluate the effect of four finishing/polishing systems (F/P) on the surface roughness and gloss of a nanofill and a micro-hybrid resin composite. The null hypotheses tested were that there would be no difference in surface roughness and gloss of micro-hybrid and nanofill resin and between different finishing/polishing systems.

2. Materials and methods

Two commercially available resin composite products, chosen in accordance with their different types of filler particles; a micro-hybrid – Esthet.X® A3 Body Shade and a nanofill – Filtek Supreme Plus Universal Restorative A3 Body Shade (3M ESPE, St. Paul, MN) were used in the present study (Table 1).

A total of 40 circular samples were prepared, 15 mm in diameter and 3 mm thick. Uncured resin composite samples were prepared by condensing them into a polytetrafluoroethylene ring mold in two increments according to the manufacturer's directions. Mylar strips were placed over the top and bottom surfaces of the uncured resin composite to prohibit the formation of an oxygen inhibition layer, and the excess material was extruded by condensing the mold in between two glass plates. The specimens were light polymerized for 40 s on each increment using the VIP Junior Dental Curing Light (Bisco, Schaumburg, IL, USA). The light output of the curing light unit was 500 mW/cm^2 and the light output was monitored with a hand-held dental radiometer (Model 100 Curing Radiometer, Demetron Research Corp., Danbury, CT, USA). The specimens were taken out from the mold immediately after the light-curing cycle, and immersed in tap water at 37 °C. They were stored in the incubator for 24 h. The top surface of each sample was roughened using 120-grit size sand paper (Carbimet, Special Silicone Carbide

Table 1 – Resin composites used in the study.

Resin composite	Type	Mean particle size	Filler type	Filler content (wt%)	Resin
Esthet-X Dentsply Caulk, Milford, DE, USA Lot #: 0611221	Micro-hybrid	0.85–0.9 μm	Barium fluoro alumino borosilicate glass and nano-sized silicon dioxide particles	77	Bis-GMA, TEGDMA, Bis-EMA
Filtek Supreme Plus 3M ESPE, St. Paul, MN, USA Lot #: 20061004	Nanofill	20 or 70 nm	Silica/zirconia filler	78.5	Bis GMA, Bis EMA, UDMA, TEGDMA