available at www.sciencedirect.com

ScienceDirect

journal homepage: www.intl.elsevierhealth.com/journals/dema

Is there one optimal repair technique for all composites?

B.A.C. Loomans[a,*], *M. Vivan Cardoso*[b], *F.J.M. Roeters*[a], *N.J.M. Opdam*[a], *J. De Munck*[b], *M.C.D.N.J.M. Huysmans*[a], *B. Van Meerbeek*[b]

[a] *College of Dental Sciences, Department of Cariology, Endodontology & Pedodontology, Radboud University Nijmegen Medical Centre, The Netherlands*

[b] *Leuven BIOMAT Research Cluster, Department of Conservative Dentistry, School of Dentistry, Oral Pathology and Maxillo-Facial Surgery, Catholic University of Leuven, Leuven, Belgium*

ARTICLE INFO

Article history:
Received 1 March 2010
Received in revised form
5 March 2011
Accepted 28 March 2011

Keywords:
Repair
Composites
Hydrofluoric acid
Sandblasting
Etching
Micro-tensile bond strength

ABSTRACT

Objectives. The aim of this study was to investigate the effectiveness of a variety of techniques to bond new composite to artificially aged composite of different compositions.

Methods. Composite resin blocks were made of five different commercially available composites ($n = 30$) (Clearfil AP-X, Clearfil PhotoPosterior, Photo Clearfil Bright, Filtek Supreme XT and HelioMolar). After aging the composite blocks (thermo-cycling 5000×), blocks were subjected to one of 9 repair procedures: no treatment (control), diamond bur, sandblasting alumina particles, CoJet™, phosphoric acid, 3% hydrofluoric acid 20 s or 120 s, 9.6% hydrofluoric acid 20 s or 120 s. In addition, the cohesive strength of the tested composites was measured. Two-phase sandwiches ('repaired composite') were prepared using each of the 9 repair protocols, successively followed by silane and adhesive (OptiBond FL) treatment, prior to the application of the same composite. Specimens were subjected to micro-tensile bond strength testing. Data were analyzed using ANOVA and Tukey's HSD ($p < 0.05$).

Results. For all composites the lowest bond strength was obtained when no specific repair protocol (control) was applied; the highest for the cohesive strength. Compared to the control for the microhybrid composite (Clearfil AP-X) five repair techniques resulted in a significantly higher repair strength ($p < 0.05$), whereas for the nano-hybrid composite (Filtek Supreme XT) and hybrid composite containing quartz (Clearfil PhotoPosterior) only one repair technique significantly increased the bond strength ($p < 0.01$).

Significance. None of the surface treatments can be recommended as a universally applicable repair technique for the different sorts of composites. To optimally repair composites, knowledge of the composition is helpful.

© 2011 Academy of Dental Materials. Published by Elsevier Ltd. All rights reserved.

* *Corresponding author at*: Radboud University Nijmegen Medical Centre, College of Dental Sciences, P.O. Box 9101, 6500 HB Nijmegen, The Netherlands. Tel.: +31 024 3616410; fax: +31 024 3540265.

E-mail addresses: b.loomans@dent.umcn.nl (B.A.C. Loomans), marcio.vivancardoso@med.kuleuven.be (M. Vivan Cardoso), j.roeters@dent.umcn.nl (F.J.M. Roeters), n.opdam@dent.umcn.nl (N.J.M. Opdam), jan.demunck@med.kuleuven.be (J. De Munck), m.c.d.n.j.m.huysmans@dent.umcn.nl (M.C.D.N.J.M. Huysmans), bart.vanmeerbeek@med.kuleuven.be (B. Van Meerbeek).

0109-5641/$ – see front matter © 2011 Academy of Dental Materials. Published by Elsevier Ltd. All rights reserved.

doi:10.1016/j.dental.2011.03.013

1. Introduction

With the introduction of dental adhesive technology, minimally invasive tooth-restoration techniques became popular [1–4]. Complete replacement of a deficient dental restoration results in further extension of the preparation [5], and therefore repair by partial replacement of the restoration or local extension adjacent to the existing restoration is recommended [6,7]. In such cases, providing sufficient attachment to the old restoration is important, which can be achieved macro-mechanically, micro-mechanically or chemically. Macro-mechanical retention can be obtained by retention holes, undercuts or by simply roughening the surface with a coarse diamond bur [8–16]. Micro-mechanical retention can be created by partially dissolving glass by breaking down the Si–O bond in SiO_2, the major component of most glass-filler particles in dental composites, by etching with hydrofluoric acid [9,16–21]. As an alternative method, sandblasting or air-abrasion can be performed with aluminum oxide powder [8,9,11,13,14,17–24]. Finally, a chemical bond may be established between resin and silica glass filler particles by application of a silane coupling agent [25–28].

As the composition of composites may differ among brands of materials, it is likely that these different materials may react differently to various repair techniques. Until now, an optimal universally applicable technique to repair various types of composite restorations has not been described. Therefore, the aim of this study was to investigate the effectiveness of a variety of repair techniques to bond composite to artificially aged composite, of different compositions. The first hypothesis tested was that there was no difference in bond strength for the different repair treatments. The second hypothesis was that all types of used composites would react in the same way to various repair techniques.

2. Materials and methods

2.1. Specimen preparation

Standardized composite blocks were made using a silicon mold with a dimension of 7 mm × 7 mm × 5 mm (Fig. 1a). Composite was injected into the mold in two horizontal layers of 2.5 mm each. The first layer was applied and polymerized for 20 s with a LED polymerization unit (LEDemetron I, Kerr, Orange, CA, USA; light intensity 600 mW/cm^2). Subsequently, the second layer was applied and a glass plate was pressed on top of the mold to create a flat superficial layer. With the glass plate in situ the composite was polymerized for 20 s. After polymerization, the composite block was removed from the mold, and post-cured from different directions for 120 s in a halogen-light curing unit (Unilux, Hereaus Kulzer, Hanau, Germany). The top surface was then polished for 15 s with a 600-grit wet silicon carbide abrasive paper, using running water as lubricant. All blocks were subjected to an aging procedure by thermo-cycling (5000 cycles, between 5 and 55 °C, dwell time: 30 s) [29]. Subsequently, the blocks were ultrasonically cleaned for 15 min in distilled water and finally stored in distilled water at room temperature for two weeks.

In addition, separate solid composite blocks (n = 3/composite material) were made to determine the cohesive strength (=positive control) of each composite. These blocks were not aged and no surface treatment procedure was applied.

Five composites were selected for this study, varying in composition and content of the filler (n = 27/group):

(a) Micro-hybrid composite heavily filled with fine barium silica glass particles (Clearfil AP-X, Kuraray Medical, Osaka, Japan).
(b) Hybrid composite heavily filled with quartz particles (Clearfil PhotoPosterior, Kuraray Medical, Osaka, Japan).
(c) Hybrid composite containing quartz, silicium oxide and pre-polymerized particles on basis of silicium oxide (Photo Clearfil Bright, Kuraray Medical, Osaka, Japan).
(d) Nano-hybrid composite containing zirconium oxide and silicium oxide (Filtek Supreme XT, 3M ESPE Dental Products, Seefeld, Germany)
(e) Micro-filled composite containing barium and silica (HelioMolar, Ivoclar Vivadent, Schaan, Liechtenstein).

2.2. Repair technique

Three blocks of each group were subjected to one of 9 different surface treatments:

1. No surface treatment (=negative control).
2. Roughening the surface with a long course diamond bur (grit: 100 μm, Komet, Lemgo, Germany) with 200,000 rpm, perpendicular to the surface of the surface.
3. Sandblasting with 50 μm Al_2O_3 powder for 20 s at a distance of 15 mm (MicroEtcher, Danville Engineering, San Ramon, USA) with a pressure of 2.5 bar.
4. Sandblasting with 30 μm SiO_2 powder for 20 s at a distance of 15 mm (MicroEtcher and CoJet™ powder, 3 M ESPE, Seefeld, Germany) with a pressure of 2.5 bar.
5. Etching with 37% phosphoric acid for 20 s (DMG, Hamburg, Germany).
6. Etching with 3% hydrofluoric acid for 20 s (Porcelock Porcelain etching, DenMat, Santa Maria, CA, USA).
7. Etching with 3% hydrofluoric acid for 120 s (Porcelock, DenMat).
8. Etching with 9.6% hydrofluoric acid for 20 s (Porcelain etch gel, Pulpdent Co., Watertown, USA).
9. Etching with 9.6% hydrofluoric acid for 120 s (Porcelain etch gel, Pulpdent).

Table 1 summarizes the product profiles, material properties and LOT-numbers of the composites selected.

After surface treatment in all groups, a silane solution (Kerr, Orange, CA, USA) was applied on top of the composite block for 15 s and gently air-dried. Then, the adhesive resin (OptiBond FL, Kerr), without dentin primer, was applied, gently air-thinned and cured for 20 s. Subsequently, a silicon mold of 7 mm × 7 mm × 9 mm was used to standardize the insertion of 4 mm of fresh composite resin material to the aged and pretreated composite block (Fig. 1c). Each specimen was repaired with the same brand of composite of a clearly distinguished shade. The composite was added in two horizontal layers and

Download English Version:

https://daneshyari.com/en/article/1421859

Download Persian Version:

https://daneshyari.com/article/1421859

Daneshyari.com