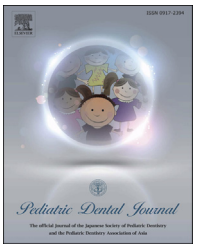
Available online at www.sciencedirect.com

Pediatric Dental Journal

journal homepage: www.elsevier.com/locate/pdj



Original Article

Influence of the bulk fill restorative technique on microleakage and microtensile of class II restorations

Alp Erdin Koyuturk, Professor[a,*], *Ugur Tokay, PhD*[a], *M. Erhan Sari, Assistant Professor*[a], *Bilal Ozmen PhD*[a], *Murat Cortcu, PhD student*[a], *Hamdi Acar, PhD student*[b], *Mustafa Ulker, Associate Professor*[b]

[a] *Ondokuz Mayis University, Faculty of Dentistry, Department of Pediatric Dentistry, Samsun, Turkey*
[b] *Selcuk University, Faculty of Dentistry, Department of Restorative Dentistry, Konya, Turkey*

ARTICLE INFO

Article history:
Received 31 January 2014
Received in revised form
7 May 2014
Accepted 30 July 2014
Available online 6 September 2014

Keywords:
Dental stress analysis
Composite dental resin
SureFil SDR flow
Microleakage
Tensile strength

ABSTRACT

Background & Aim: The aim of this study is to evaluate microleakage and bond strength test of the bulk fill restorative technique.
Materials and methods: ÆLITE LS Posterior and SureFil SDR flow were used as composite restoration, and Clearfil S^3 (Self Etch system) Bond and Prime&Bond NT (Total Etch system) were used as bonding agents. Standardized Class II cavities were made on sixty extracted premolar teeth and they were randomly divided into four groups. Thermo-cycling and mechanical loading was applied to all samples. The samples were stored in the %2 basic fuchsine solutions and the microleakage was evaluated.
Results: When total etching system groups were evaluated, the cervical microleakage values were higher than occlusal microleakage values on both composites ($P < 0.05$), but there were no differences between the self-etch groups. Microtensile test was also applied to the samples. When the MPa values of all groups were compared, there was a very significant difference statistically ($P < 0.001$).
Conclusions: The results support the conclusion that the SureFil SDR flow exhibited the best performance in occlusal margins of Prime&Bond NT-SureFil SDR groups.

1. Introduction

Since Bowen announced resin-based composite material in 1960s [1], a lot of changes occurred in composites' mechanical and physical properties [2]. Resin-based restorative composites generally are characterized as free radical polymerization reaction between monomers and methacrylate groups [3]. Although most properties of composites have been improved (physical, optical and mechanical), they still have

* *Corresponding author*. Tel.: +90 362 3121919; fax: +90 362 4576032.
E-mail addresses: alperdinkoyuturk@hotmail.com, dtugurtokay@gmail.com (A.E. Koyuturk).
http://dx.doi.org/10.1016/j.pdj.2014.07.002

polymerization shrinkage and stress [4]. This disadvantage causes clinical problems, such as bacterial invasion, secondary caries, pulpal inflammation, pulpal necrosis, and sensitivity in patients. Additionally, different modifications polymerization reaction and changes in filler amount, monomer structure and chemistry are new approaches [5].

In order to minimize the polymerization shrinkage stress on the tooth-composite, a lot of methods such as cavity reconstruction [6], different curing methods [7,8] and stress absorbing intermediate layers [9] are recommended. When flowable liners such as flowable composite, SDR, etc. were evaluated, it was observed that they reduced sensitivity, developed better adaptation to dentinal surfaces, and caused less leakage on the interface between restoration and tooth structure [10]. In order to reduce polymerization shrinkage, bulk-fill flowable resin-based Smart Dentin Replacement (SDR) composite materials were developed [11]. It is advocated by the manufacturers that modified methacrylate resins in SDR have slow polymerization rate owing to the polymerization modulator [12].

The aims of this study were as follows: **a**. to evaluate occlusal and marginal microleakage of SDR **b**. to investigate dentin bond strength of SDR after thermal and thermo-mechanical load cycling. The null hypothesis was tested and it was established that bulk fill placement technique of new composite resin would neither increase the dentin bond strength, nor will it reduce the marginal microleakage.

2. Materials and methods

Sixty premolar teeth extracted due to orthodontic reasons were included in this study. Scaling and soft tissue removing was applied before applications. The teeth were stored in 0.1% thymol solution. Mesiooocclusal (MO) or distooclusal (DO) standard class II cavities were prepared on teeth.

Sixty teeth were randomly divided into four groups. They were total etching & posterior composite group (TE-POS), total etching & SDR (TE-SDR) group, self-etching & posterior composite (SE-POS) group and self-etching & SDR group (SE-SDR). The materials used are shown in Table 1.

Sixty standardized Class II cavity preparations (MO or DO, 5 mm in depth occlusally, and 2 mm in mesio-distal direction at the bottom of the proximal box) with the distal proximal margin located 1–2 mm below the cemento–enamel junction were performed. Cavities were cut using diamond burs under water. Adhesive systems (ETCH-37 (37%) w/BAC & Prime&Bond NT and Clearfil S^3 Bond) were applied according to manufacturers' instructions. Posterior composites were applied to all the cavities and then light cured for 40 s with a halogen light source (LUNAR, Benlioğlu INC, TURKEY). 4 mm of SDR was applied to a proximal cavity and 1–2 mm posterior composite was applied above the SDR and light cured for 40 s.

All of the samples ($n = 60$) were thermocycled for 10,000 cycles in thermal cycling device (Dentester, Salubris-Technica, Turkey) from 5 °C to 50 °C. The staying time at each temperature was 30 s in each bath; the transport time between the water baths was 5 s.

Mechanical loading was applied for 50,000 times with chewing simulator device (Vega chewing simulator, Nova Tic, Konya, Turkey) to all of samples ($n = 60$). Samples were fixed to simulator device; center of each tooth was occluded against a stainless steel antagonist (5 mm in diameter). A mechanical load power was set 50 N and device's frequency was set 0.5 Hz [13].

2.1. *Microleakage test*

Prior to marginal leakage process, all teeth apexes were plugged by dental wax. All teeth were covered with nail polish up to 1 mm border of filling materials. All samples were restored in the %2 basic fuchsine solutions. The teeth were rinsed under running water for 5 min to remove solutions. The teeth were sectioned longitudinally through the middle of the restorations mesio-distally using a diamond saw (Isomet–Buehler, Lake Bluff, IL, USA) under water lubrication. Dye penetration into the gingival margin and occlusal margin was evaluated under a stereomicroscope (SZ-TP, Olympus, Tokyo, Japan) at 40X and independently scored by two examiners on a 0 to 3 scale as follows [14]:

Table 1 – Brand names, batch numbers, manufacturers and ingredients of tested materials.

Brand name	Batch number	Manufacturer	Ingredients
Clearfil S^3 Bond	00160A	Kuraray, Osaka, JAPAN	10-MDP, Bis-GMA, HEMA, DMA, camphoroquinone, ethanol, water, silanated colloidal silica
Prime&Bond NT	101200907	Dentsply, GERMANY	Di- and trimethacrylate resins, Functionalised amorphous silica, PENTA (dipentaerythritolpenta acrylate monophosphate), Photoinitiators, Stabilizers, Cetylaminehydrofluoride, Acetone
ETCH-37 (37%) w/BAC	1300002271	Bisco, USA	37% H_3PO_4, benzalkoniumchloride (BAC)
ÆLITE LS Posterior	1100009922	Bisco, USA	Ethoxylated Bis-GMA, Glass Filler, Amorphous Silica
SureFil SDR flow	1101201	Dentsply, GERMANY	Barium-alumino-fluoro-borosilicate glass, Strontium alumino-fluoro-silicate glass, Modified urethane dimethacrylate resin, Ethoxylated Bisphenol A dimethacrylate (EBPADMA), Triethyleneglycol dimethacrylate (TEGDMA), Camphorquinone (CQ) Photoinitiator, Photoaccelerator, Butylated hydroxyl toluene (BHT), UV Stabilizer, Titanium dioxide, Iron oxide pigments, Fluorescing agent

10-MDP: 10-Methacryloyloxydecyl dihydrogen phosphate, Bis-GMA: Bisphenol-A diglycidylemethacrylate, HEMA: hydroxyethylmethacrylate, DMA: dimethacrylate.