ORIGINAL RESEARCH PAPER

Volume-8 | Issue-4 | April-2019 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ASSESSMENT OF MARGINAL MICROLEAKAGE OF TWO BULK FILL COMPOSITES USING DIFFERENT FINISHING AND POLISHING SYSTEMS: AN IN VITRO STUDY

Dental Science

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ABSTRACT

Aim : To evaluate microleakage of two bulk fill composites with two different finishing and polishing systems.

Methodology : Standard class V cavities were prepared on the buccal surface of sixty human premolars extracted for orthodontic purpose. The cavities were etched, bonding agent applied and composite was placed. The premolars were then divided into six groups based on the composite and finishing system used. Teeth were immersed in 0.6% rhodamine dye and sectioned using hard tissue microtome which were further analysed using confocal laser scanning microscopy for microleakage. Data was subjected to statistical analysis.

Results: No significant difference was observed between the tested groups for microleakage analysis, but significant difference was seen between the control and tested groups.

Conclusion: Sonic Fill groups demonstrated less microleakage compared to Filtek Bulk fill composite groups.

KEYWORDS

Confocal laser scanning microscopy, microleakage, SonicFill, Shofu and SS White finishing and polishing systems

INTRODUCTION

In the last decade, an increasing demand for aesthetic and mercury free restorations has propelled a surge in the use of resin based composites.[1] Dental composites introduced in early 1960's have undergone a lot of revolution, exploration and refinement.[2] Despite many advantages, the main drawbacks are polymerization shrinkage, gap formation, microleakage, stains, postoperative sensitivity, recurrent caries, surface wear and roughness.[3,4] To reduce these failures, several methods such as incremental technique placement, ceramic inserts and sandwich technique were most commonly used.[5]

Even though incremental filling technique allows deeper penetration of curing light, problems such as inadequate sealing of the restoration, postoperative sensitivity and early failure of the restoration are also common due to areas of uncured or partially cured resin at the base or between layers of each increment.[6]

To compensate for above failures, Bulk fill composites were introduced which can be placed in increments of 4-5 mm thickness with increased depth of cure. This is achieved by increasing filler size or by adding different photoinitiators.[7,8] Several bulk fill composites including flowable and sculptable viscosity formulations are available which include a stress reliever (e.g. Tetric N Ceram Bulk Fill, Tetric N Flow Bulk Fill, Tetric EvoCeram Bulk Fill) or polymerization modulator (e.g. SureFil SDR).[9,10]

A contemporary sonic activated bulk fill composite, SonicFill introduced by Kerr in the year 2010 contains fillers mainly silica and barium aluminosilicate of 83.5% by weight. This system consists of a handpiece with a Kavo tip, attached to a highspeed multiflex connection. A special composite unidose is screwed on the handpiece which upon activation lowers the viscosity due to sonic energy and extrudes the composite. Upon deactivation, viscosity of the composite increases allowing easy adaptation and sculpting.[11,12]

Filtek Bulk Fill (3M ESPE), a low-viscosity, visible-light activated flowable material for filling with bulk fill technique, is manufactured in four shades (each of which may be polymerized in 4 mm increments according to international ISO standards) and two kinds of packaging, capsules and syringes. It contains Bis-GMA, UDMA, Bis-EMA, and Procrylat resins. Fillers are a combination of zirconia and silica having a particle size of 0.01–4.5 microns and ytterbium trifluoride filler having a particle size of 0.1–5.0 microns. The inorganic filler loading is approximately 64.5% by weight (42.5% by volume).[13,14]

Finishing and polishing is one of the critical factors which improves longevity and esthetic quality of a restoration. Improper surface finishing of restorations can result in plaque accumulation, gingival inflammation, periodontal problems, caries and poor esthetics.[15] Another essential factor in determining the preservation of restoration is the absence of marginal microleakage. Clinical consequences of microleakage are secondary caries, pulp inflammation, marginal discoloration, postoperative sensitivity and the reduction of longevity of filling.[16,17]

Hence, this study aims to evaluate the marginal microleakage of two different bulk fill composites SonicFill and Filtek Bulk fill using two different finishing and polishing systems Shofu and SS White. Surface marginal microleakage was assessed by 0.6% rhodamine dye penetration method under Confocal laser scanning microscopy.

MATERIALS AND METHODS

Sixty human permanent maxillary premolars freshly extracted for orthodontic purpose were selected. Teeth without any caries, deformities, cracks and restorations were included in this study. Calculi and residual soft tissue on teeth were removed carefully and stored in 0.5% Thymol at room temperature until further use.

Standardized Class V preparations were made on the exposed buccal surface with dimensions of 2mm depth, 3mm width and 2mm in height with # 245 bur (SS White, Lakewood,NJ, USA) in an air/water-cooled high speed turbine handpiece.

The cavity on each tooth was etched with proetchant gel (SS White, Lakewood, New Jersey) for 15 sec followed by cleaning with gentle water spray for 20 sec and dried. NT Prime & bond (Dentsply Caulk, Milford, U.S.A) was applied on the etched surface according to the manufacturer's instructions and cured for 20 sec with LED lightcuring unit operating at 650mw/cm^2 (XL 3000, 3M ESPE). The teeth were then randomly divided into following six groups based on the composite (A2 shade) placed and the finishing and polishing systems used.

Group1: SonicFill without finishing and polishing
Group 2: SonicFill with Shofu finishing and polishing
Group 3: SonicFill with SS White finishing and polishing
Group 4: Filtek Bulk fill without finishing and polishing
Group 5: Filtek Bulk fill with Shofu finishing and polishing
Group 6: Filtek Bulk fill with SS white finishing and polishing

All specimens of finishing and polishing were completed with a slow-speed handpiece using water in a planar motion.

Evaluation of Microleakage

All the teeth were then submitted to 500 thermocycles of 5ºC and 55ºC for 30 sec each and dwell time of 10 sec in a resting bath at 24ºC. They were subsequently sealed with two coats of nail varnish applied 1.5mm short of the restoration margins and then immersed in 0.6% rhodamine dye for 48 hrs at 37°C. After removal from dye solution, the teeth were cleaned sufficiently with distilled water and mounted further into acrylic moulds. These were then sectioned longitudinally through the restorations in a bucco-palatal plane using a hard tissue microtome (Leica SP 1600, Leica Biosystems, Wetzlar, Germany) under water irrigation (fig 1). The 150µ thin sections were then subjected to confocal laser microscopy (LSM 700, Zeiss, Oberkochen, Germany) for microleakage analysis (fig 2)

Fig 1: sectioning through hard tissue microtome

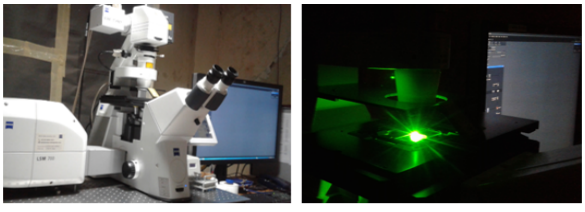


Fig 2: Confocal Scaning Electron Microscopy

A 0-3 scoring system was used to describe the severity of dye penetration:
0 = no evidence of dye penetration
1 = dye penetration to less than half the cavity depth
2 = dye penetration to the full cavity depth
3 = dye penetration to the axial wall and beyond.

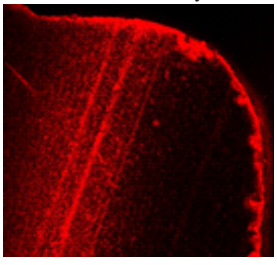


Fig 3: (Group 1) SonicFill : Control group

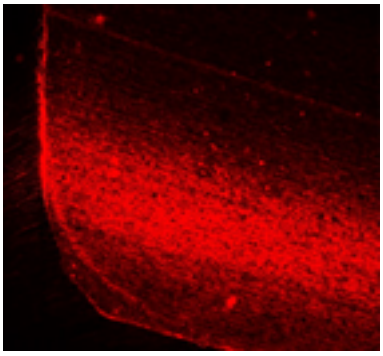


Fig 4: Group 2
SonicFill : Shou group

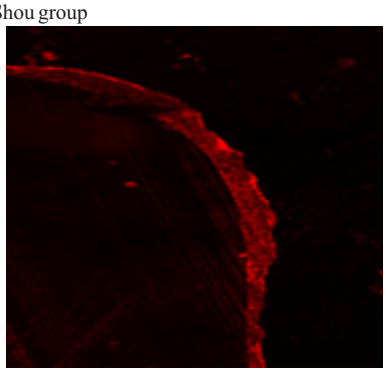


Fig 5 (Group 3)
SonicFill : SS White group

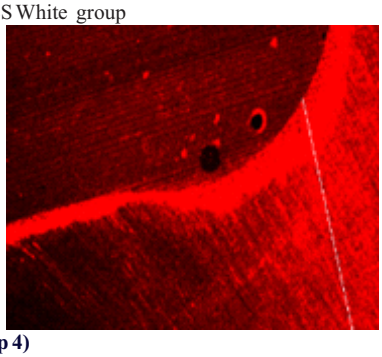


Fig 6 (Group 4)
Filtek Bulk fill : Control group

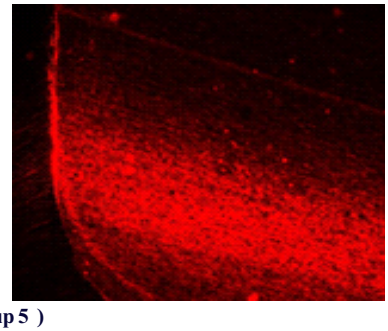


Fig 7 (Group 5)
Filtek Bulk fill: Shofu group

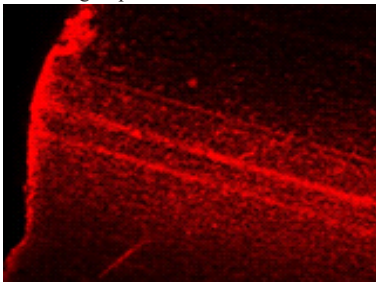
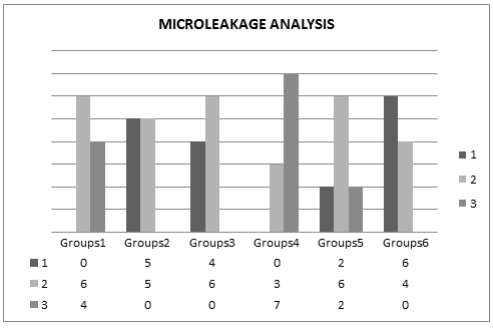


Fig 8 (Group 6)
Filtek Bulk fill: SS White group

RESULTS

Kruskal Wallis test has elicited no statistical significant difference of microleakage between the tested groups but statistical significant difference was observed in Chi-square analysis between the control group and tested groups. Among the tested groups, severity of microleakage was more in the control groups followed by tested groups of Filtek Bulkfill and SonicFill which is in descending order as follows:

Group 4>Group 1>Group 5>Group6>Group3>Group 2 as depicted in graph 1



Graph 1

DISCUSSION

Surface smoothness of a composite restoration is essential for the ultimate success and longevity which results from the interaction of many factors. Intrinsic factors includes the type of resin matrix; filler type, shape, size and distribution; the degree of final cure and filler/matrix interface. Extrinsic factors associated are the type of polishing system, the hardness of the abrasives and the geometry of instruments.[18]

All abrasive finishing and polishing devices are categorised as coated abrasives, bonded abrasives, loose abrasives and multifluted tungsten carbide finishing burs.[19] In the present study, SS White and Shofu finishing and polishing systems were used. SS White finishing and polishing system consists of a convenient selection of trimming and finishing burs and one-step polishers.[19,20] The Shofu finishing and polishing kit consists of a combination of Dura green and white stones. Green stones contain silicon carbide and are excellent for fast contouring and finishing. White stones made up of aluminum oxide, are ideal for fine contouring and polishing.[19,21] The samples in the present study were finished and polished after 24 hrs to achieve smooth surface which is in agreement with study done by Madhyastha et al.[22] Planar motion used in this study achieved the lowest surface roughness values which is similar to study of Fruits et al. [23]

Several techniques used to measure microleakage are application of compressed air, bacterial, chemical and radioactive markers, electrochemical investigations, scanning electron microscopy, dye penetration and recently micro CT images.[24] In this study, 0.6% Rhodamine dye in conjugation with Confocal laser scanning microscopy (CLSM) at 10X magnification was used. This dye provides a simple, relatively inexpensive, quantitative and comparable method for evaluating various composite systems.

CLSM can operate both in bright field as well as in fluorescence mode and used to image any thick biological samples in three dimensions. An advantage of this technique is the use of lens focus which can focus a few microns beneath the observed surface and hence avoids polishing artifacts. The CSLM scans the sample and assembles the pixel information into one image.[25]

Within the limitations of this invitro study, none of the tested bulk fill composites completely eliminated microleakage and dye penetration in enamel and dentin. This is due to SonicFill having highly filled proprietary resin and filler particles space does not participate in the curing contraction. Also, it has increased percentage of photoinitiator that provides adequate degree of conversion at the bottom of cavity. The sonic waves applied through the handpiece cause the viscosity of the composite to drop to 87% which increases the flowability, quick placement, and precise composite adaptation.[11,12]

Few limitations of the present study, includes the variations in the stress among different cavities and laboratory tests should only be compared to clinical situation when walls of similar geometry are used.[26]

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