Proceeding of The 14th FDI-IDA Continuing Dental Education Programme

"Advancing Dentistry with Innovative Sciences and Technology"

Novotel Manado Convention Center, Manado September 20-22, 2018

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FOREWORD

Continuing dental education is a lifelong process for dentists who seek excellence in providing the best and current service to their patients. Scientific and technological advances in dentistry has been progressing rapidly in the last few years. Consequently, patients' needs and expectations to receive the highest standard of dental care has also increase.

World Dental Federation (FDI) in conjunction with Indonesian Dental Association hold international scientific meeting and dental exhibition annually. This year, the event will be organized in Manado. It provides a great opportunity for dentists and dental students, in the eastern part of Indonesia especially, to gain knowledge and update their skills.

The theme of this year's meeting is " Advancing Dentistry with Innovative Sciences and Technology" which will enable an international platform for the discussion of the latest findings and future technologies in dentistry.

Chairman,
Sanil Marentek

CONTENTS

RESEARCH

Microleakage Comparison of Various Bulk Fill Composite in Class I Restoration with Bulk Technique

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Abstract

Introduction: Bulk fill composite resin developed to applied in a cavity up to 4 mm of depth and shrinkage can be minimized during polymerization. Bulk fill composite resin in its development has a lower microleakage value than conventional composite resin. The aim of this study was to compare the microleakage of three bulk fill composite resin filled in class I cavity with bulk technique. Method: Thirtytwo human maxillary premolars were stored in distilled water. Each tooth was planted into a cast box and class I cavities were prepared. Samples were divided into four groups. Control group was filled with conventional composite resin. Group 2, 3, and 4 was filled with bulk fill composite resin and then stored in an incubator at 37ºC for 24 hours. Samples were manually thermocycled for 100 times at 5ºC and 55ºC, then immersed in 1% methylene blue solution for 24 hours. Microleakage were measured by Digital USB Microscope with 100x magnification in milimeters from occlusal-pulp wall. Result: The result showed that group 2 has the lowest of microleakage value and control group has the highest. Data were analyzed by one-way ANOVA and post hoc LSD test. The result showed that the microleakage value were significantly different among all treatment groups and control group, and between group 2 with group 3 and 4, but there is no significant difference between group 3 and 4. Conclusion: It can be concluded that bulk fill composite resin with specific initiator component has the lowestmicroleakage value.

Keywords : Bulk fill composite resin, Class I cavity, Microleakage

Introduction

Dental composites is a direct restorative material, composed mainly of organic resin matrix, inorganic filler particles, coupling agent, and minor additions of polymerization initiators, stabilizers and coloring pigments.[1] Major drawbacks of composite resins is polymerization shrinkage that may lead to marginal microleakage and clinical failures. Composites undergo volumetric shrinkage of 2–6 % upon setting that creates contraction stresses between the composite and the tooth. This stress can even exceed enamel’s tensile strength and result in stress cracking and enamel fractures along the interfaces.[2]

Another disadvantage of conventional light curing composites is their limited depth of cure, with maximum increment thickness not more than 2 mm. Therefore, a layering technique is necessary to obtain sufficient conversion, especially for deep cavities such as class I cavities.[3] However, incremental application of composite resins has drawbacks such as risk of void formation and contamination, bond failure between layers, difficult application of composite in conservative cavities and time consuming.[4]

Recently, new materials have been marketed as bulk-fill resin-based composites, which can be cured in layers up to 4 or 5 mm. The resin material have a higher translucency to allow a deeper penetration of the polymerizing light. Other manufacturers adding new photoinitiator which significantly increases the reactivity of the monomer.[5] The bulk-fill composites can be categorized into two groups; the base materials also referred to as flowable bulk-fill composites and full-body bulk-fill composites that usually have high viscosity.[6]

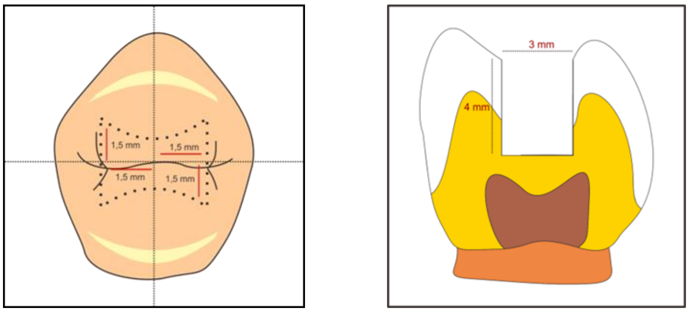
Previous studies has investigated the properties of various marketed bulk-fill composites with various results. Patel et al. evaluated and compared microleakage in class II cavities restored with three different novel bulk fill composites. The results showed that all the restored groups showed microleakage, but bulk-fill composite showed the least microleakage while the conventional composite when filled in bulk showed the worst results.[7] Other study found that incidence of gap-free margins of conventional composites tested placed in increments appeared to be lower than bulk-fill composites, although the difference is not significant.[8] Meanwhile, Rengo et al. reported no significant difference between marginal leakage of bulk fill composite restorations in permanent teeth compared to conventional composites.[9] This study aimed to asses the microleakage of three bulk fill composite resin filled in class I cavity using the bulk fill technique.

Methods and Materials

This in vitro experimental study was conducted on extracted 32 permanent maxillary premolars. The teeth were sound and had no carious lesions, with fully formed root and apical foramen is completely sealed. All samples were cleaned, kept in distilled water and refrigerated until one week prior to the experiment.

The teeth were embedded in gypsum blocks from apex to cementoenamel junction (CEJ) and occlusal part of the tooth is facing upward. A class I cavity was prepared on the center of the tooth as illustrated in Figure 1 using a round diamond bur and high speed hand piece under water irrigation to open the cavity. The preparation continued with cylindrical diamond bur to create parallel axial walls with 4 mm occlusogingival depth and 3 mm buccopalatal and mesiodistal width.[10] A probe was used to ensure the uniformity of cavity depth. After the preparations were completed, the teeth was cleaned with distilled water, dried, and randomly divided into four groups (n = 8) according to the material to be tested. One conventional composite was used as control, and three commercial bulk-fill composite systems were used as treatment groups.

Group I : SB Universal Adhesive/FZ350 XT Conventional composite
Group II: TNB Universal/TNC Bulk Fill
Group III: FB Bonding agent /XTF Bulk Fill
Group IV: SB Universal Adhesive/FT Bulk Fill



(a) (b)

Fig.1 Illustration of the Class I preparation. a) Occlusal view b) proximal view

All restorations were made by one operator. Placement and curing of each dentine bonding agent, as well as the subsequent resin composite material, was done according to all manufacturer instructions. The composites, including the control group, was applied in bulk technique with 4 mm thickness. The bulk fill composites group and control group was cured for 10 and 20 seconds respectively from the occlusal surface by using LED light curing unit with light intensity 1000 mW/cm^2.

The restoration surface was then polished by using rubber cup white, and then the samples was detached from gypsum blocks and cleaned thoroughly. All samples were kept in distilled water in the incubator in 37oC for 24 h. All specimens were then subjected to manual thermocycling at 5°C and 55°C for 3000 cycles, with 150 seconds dwell time at each bath. Apices were sealed with baseplate wax, and tooth surfaces were then covered with a layer of nail varnish to 1mm around the restoration margin. Next, the teeth were immersed in methylene blue 1% solution for 24 h. Afterwards, the teeth were cleaned with nail polish remover, washed thoroughly with distilled water and dried.

After drying, the teeth were sectioned at CEJ by a high speed diamond separating disc under water coolant to separate coronal and apical part, and then sectioned vertically in bucopalatal direction perpendicular to the longaxis of the tooth.Each slice was evaluated under a USB Digital Microscope at 100x magnification.

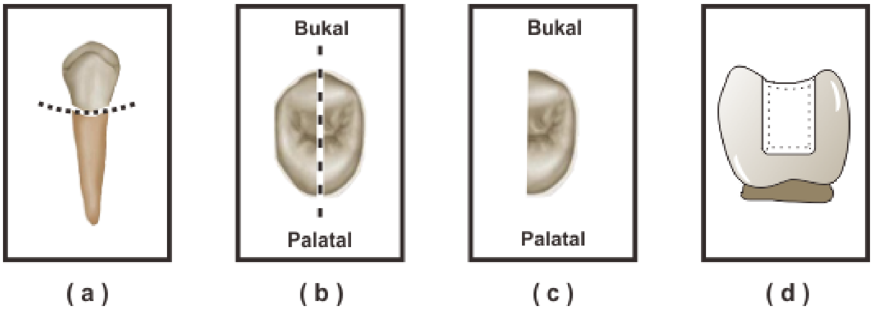


Fig. 2. Sample preparation for microleakage test. a) Teeth sectioned at CEJ; b) Vertical section in bucco-palatal direction at the center of the tooth; c) The coronal part; d) specimens from proximal view.

Fig.3 Specimens mounted in round baseplate wax.

Specimens was mounted in round baseplate wax with diameter 1cm to fixate the specimens on to microscope (Fig. 3). The depth of the penetration was analyzed based on the mini scale. SPSS version 16 was used to analyze the statistical data.

Results

The results obtained was the length of methylene blue infiltrations on the occlusal-pulpal walls of the cavities measured with digital calliper, that shown in Figure 4.

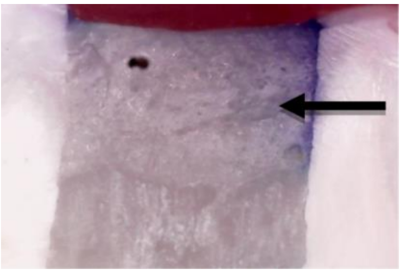


Fig. 4 Microscopic images of the crosscut surfaces of specimen (original magnification ×100). The arrow shows the margin of the filling with blue color indicating dye penetration.

The mean values and standard deviation of dye penetration depth (microleakage) for the three types of bulk-fill and one conventional composites are reported in Figure 5. The control group (conventional composite FZ350XT exhibited the highest dye penetration, and specimens filled with TNC Bulk Fill composite demonstrated the lowest dye penetration among the tested materials.

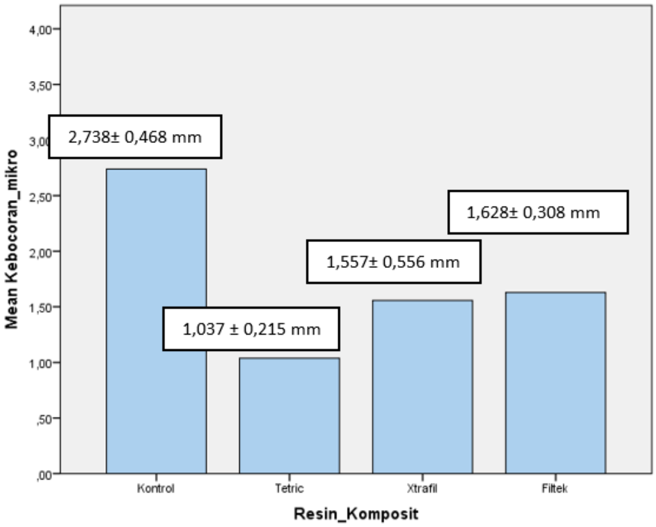


Fig. 5 The mean (SD) of microleakage in control and experimental groups.

Further the data was subjected to the One Way ANOVA, and the outcomes are depicted in Table 1. The value of $p < 0.05$ indicates statistically significant difference between the groups under study, and proceed with LSD Post Hoc test. The results are presented in Table 2.

As shown in Table 2, there was a statistically significant difference ($p<0,05$) in microleakage between control group (group 1) and all the treatment group (group 2, 3, 4). The difference between group 3 and group 4 was not statistically significant.

Table 1. Statistical analysis of the values of mikroleakage in all groups.

	Sig.
Between groups	0,000

One Way Anova Test, p<0,05

Tabel 2. LSD post hoc comparison between each of the restored group

	Group1 (FZ350XT)	Group 2 (TNC)	Group 3 (XTF)	Group 4 (FT)
Group 1 (FZ350XT)		0,000*	0,000*	0,000*
Group 2 (TNC)			0,017*	0,007*
Group 3 (XTF)				0,731
Group 4 (FT)				

* : Significant difference

Discussion

This study assessed the microleakage of class I cavity prepared in human teeth and restored with three bulk-fill and one conventional composite and found that no specimens were completely free from microleakage, that may attributed to polymerization shrinkage.

Polymerization shrinkage of composites materials occurs because monomer molecules are converted into a polymer network and therefore, exchanges Van der Walls spaces into covalent bond spaces creating contraction stresses in the resin composite. The magnitude of the stress induced during polymerization shrinkage depends upon other factors, such as the configuration factor (C-factor) of the cavity.[11]

The C-factor refers to the ratio of bonded-to-unbonded restoration surfaces, with a direct correlation shown between preparation C-factor and internal polymerisation stress development at the bonded interface. If the force of polymerisation shrinkage exceeds the strength of the bonding agent and composite interface, a marginal gap can form to accommodate this strain.[8]

The results of this study demonstrated that microleakage of conventional composite (FZ350XT) was statistically significant compared to the bulk-fill composites. This is in line with results reported by El-Damanhoury and Platt who found that all bulk-fill composites induced less shrinkage stress than the conventional composite they used as control.[12] It is generally believed that the conventional composite materials should be placed in cavity not greater than 2 mm increments. In the present study, conventional composite was applied with bulk technique of about 4 mm thickness. This might prevent adequate polymerization of resin composites. During the polymerization of a thicker increment, the material can pass through the gel point at different times at different depths. When the superficial material layers are already in postgel phase, the deeper layers have not yet reached the gel point. The superficial part of the material becomes firm, and the deeper part is still not completely polymerized.[13] Application of large increments triggers a shrinkage stress rise, and this may explain why the conventional composites showed the highest dye penetration among the restorative materials. However, other study suggested a different result. When using conventional material in incremental method, the incidence of gap-free margins at both the enamel and dentine interfaces appeared to be much lower than when using in bulk, and no significant difference between the bulk–fill materials.8 In addition, bulk-fill composites differ from conventional composites in their increased depth of cure (DOC), which can mainly be attributed to a higher translucency to be able to polymerize to deeper depths.[14]

Among the bulk-fill materials tested in this study, TNC Bulk Fill showed the lowest microleakage score and there was significant difference with specimens filled with XTF and FT Bulk Fill. This may be related with the type of photoinitiator. TNC Bulk Fill contains a dibenzoyl germanium derivative, referred to as Ivocerin, as an additional photo-initiatior besides the camphorquinone/amine photo-intitiator. Ivocerin features a high absorption coefficient, with its maximum in the wavelength range of 370 to 460 nm. It is more reactive than camphorquinone resulting in more rapid polymerization with greater depth of cure.[14] Moreover, TNC use pre-polymer shrinkage stress reliever technology and photosensitive fillers that may potentially reducing contraction during polymerization.

Meanwhile, Fig. 5 showed that XTF has slightly lower microleakage values compared to FT Bulk fill, with no significant difference. This seem to be positively correlated with the filler content. XTF (86 wt%) contains more inorganic filler than FT Bulk Fill (77 wt%), affecting the mechanical properties. Both composites use Camphorquinone as photoinitiator.[14]

Adequate clinical performance of direct composite restorative materials is influenced by so many factors. Within the limitations of the present work, it can be stated that in terms of microleakage, bulk-fill composites show better results than the conventional. The saving of time and simplification by the bulk filling procedure is a clear advantage of bulk-fill composites. However, bulk-filled systems may have different types of photointiators and thus require curing lights that adequately activate them.[8]

Conclusion

The results of the present study suggest that bulk fill composite resin with specific initiator component has the lowest microleakage value.

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