

COMPARISON OF COMPOSITE BULK FILL MICROLEAKAGE LEVEL AND INCREMENTAL BULK TECHNIQUE COMBINATION IN CLASS I CAVITY RESTORATION

(PERBANDINGAN TINGKAT MIKROLEAGE SETELAH RESTORASI KOMPOSIT BULK FILL MENGGUNAKAN TEKNIK BULK DENGAN TEKNIK BULK KOMBINASI INKREMENTAL PADA KAVITAS KLAS I)

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ABSTRACT

Microleakage is the formation of gaps on the surface of the restoration, which several factors can cause. Restorative material was developed to reduce microleakage. Bulk-fill composite resins are made to accelerate the process of composite resins when restored. Bulk-fill allows clamping to be done at once with a thickness of 4 mm and undergoes minimal polymerization shrinkage. The study aims to determine the microleakage in bulk restoration techniques and combination with bulk incremental in class I preparations differences. This research is an experimental laboratory study using a post-only group design. Thirty-two samples of maxillary premolar teeth were divided into two groups,

with sixteen samples for each group. In group 1, the samples were restored by bulk technique, and in group 2 were restored using a combination of bulk and incremental techniques. All samples were immersed in 0.2% blue methylene solution for 24 hours. Microleakage was measured using a 50x magnification stereomicroscope using a micrometer ruler in millimeter microscope units with an accuracy of 0.1 mm. The results showed that the microleakage value in the bulk technique was more significant than in the combination technique. Data were analyzed using univariate tests. The analysis showed significant differences between the two groups ($p < 0.05$). This study concludes that the composite resin's restoration with a combination of bulk and incremental techniques produces smaller microleakage than the bulk technique.

Keywords: bulk-fill; bulk incremental; microleakage

ABSTRAK

Mikroleakage adalah terbentuknya celah pada permukaan restorasi yang disebabkan oleh banyak faktor. Bahan restorasi yang banyak dikembangkan bertujuan untuk mengurangi mikroleakage. Resin komposit bulk-fill merupakan resin komposit yang dibuat dengan tujuan mempercepat proses resin komposit saat direstorasi. Konsep bulk-fill memungkinkan penumpatan dilakukan sekaligus dengan ketebalan bahan 4 mm dan mengalami polymerization shrinkage yang minimal. Telah dilakukan penelitian eksperimental laboratoris dengan desain post only group. Untuk mengetahui perbedaan mikroleakage teknik restorasi bulk dan kombinasi bulk dengan inkremental. Penelitian ini adalah penelitian laboratorium eksperimental menggunakan Penelitian ini adalah penelitian laboratorium eksperimental menggunakan desain kelompok kontrol post-test only. 32 sampel gigi premolar rahang atas dibagi menjadi dua kelompok dengan total 16 sampel untuk setiap kelompok. Pada kelompok 1, sampel direstorasi dengan teknik bulk dan kelompok 2 direstorasi dengan menggunakan

teknik kombinasi teknik bulk dan inkremental Sampel direndam dalam larutan metilen biru 0,2% selama 24 jam. Pengukuran kebocoran mikro dilakukan menggunakan stereomikroskop pembesaran 50 x menggunakan penggaris mikrometer dalam satuan mikroskop milimeter dengan akurasi 0,1 mm. Hasil pengukuran tingkat microleakage dalam penelitian ini menunjukkan nilai microleakage yang terjadi pada kelompok 1 berkisar 1,1 mm - 3,7 mm dengan rata-rata 23,84 mm, pada kelompok 2 microleakage yang terjadi berkisar 0,4 mm – 1,1 mm dengan rata-rata 9,16 mm. Data di analisis menggunakan uji univariat. Hasil analisis menunjukkan terdapat perbedaan yang signifikan antara kedua kelompok ($p < 0,05$). Adapun kesimpulan yang dapat diperoleh dari penelitian ini adalah Kesimpulan penelitian ini adalah restorasi resin komposit dengan teknik kombinasi bulk dengan inkremental menghasilkan microleakage yang lebih kecil dibandingkan dengan teknik bulk.

Kata kunci: bulk-fill; inkremental; microleakage; teknik bulk

INTRODUCTION

Composite resin is a restorative material with a high aesthetic value compared to other restorative materials and is widely used today.¹ Along with developing dental adhesive systems, making restorations using composite resins has become an essential part of dentistry, as well as increasing patient needs for aesthetics and the demand to maintain tooth structure.² The advantages of composite resins for posterior tooth restorations are that they are easy to manipulate, have good mechanical properties and are resistant to

wear and tear. Composite resin has drawbacks, namely poor adaptation to the cavity edges, wear and tear porosity, and polymerization contraction resulting in microleakage in composite restorations.^{3,4}

Microleakage is a gap formed due to poor adaptation between the restorative material and the surface of the cavity wall. It causes the penetration of bacteria, fluids, molecules, and ions through the gap. The causes of microleakage are differences in the structure of enamel and dentin, different types of composite resin, inadequate bonding, and the effect of irradiation on

composite resin restorations.²

The success of a restoration can be influenced by the technique used, as it is known that composite resin restorations can be carried out using the bulk-fill technique, so now a modification has been developed between bulk and incremental techniques. The advantage of the bulk-fill technique is that it can produce less space and save processing time.⁵ The bulk-fill technique disadvantage is one filling and irradiation so that polymerization shrinkage quickly occurs. It affects the results of the restorative material and the mechanical properties of the filling.⁵ The Combining bulk-fill with incremental is called the "two-step amalgam-like sculpting technique." It used a bulk-fill composite to construct the core in a single layer, leaving space from the margin and for the last layer using conventional composites. The advantages are less treatment time and can reduce polymerization contraction pressure. While long-term clinical, the technique has no implications.⁶ Difference between bulk-fill composites and conventional composites is the addition of modifiers such as shrinkage stress reliever, which reduces polymerization shrinkage. Some manufacturers change their chemical formula to increase the irradiation depth of bulk-fill composite resins.⁷

Based on the description above,

the authors are interested in comparing microleakage levels after bulk fill composite restorations using bulk techniques with combined incremental bulk techniques in class I cavities.

METHOD

This research used an experimental laboratory study using a post-test-only control group design. This study's total number of premolars was 32 maxillary premolars divided into two groups, with 16 samples for each group. Each sample from the two groups was prepared with a class I cavity preparation with a square shape, with a depth of 4 mm for each cavity. In group 1, the sample was restored by technique bulk, and in group 2 was restored using a combination of bulk and incremental techniques. The samples were stored in an incubator at 37°C for 24 hours, then *thermocycling* in manual 100 revolutions at 5°C and 55°C. Each sample soaked in 0.2% methylene blue solution first covers the tip of the tooth's root with sticky wax so that the dye does not penetrate the tip. Cover the entire tooth surface using clear nail polish except for the restoration area, especially on the edges of the restoration. Soak the sample in 0.2% methylene blue solution for 24 hours in a mica tube. After cleaning the sample using acetone, irrigate using distilled water and dry it. Before

observation, cut in the middle of the restored tooth using a *separating disc*. The microleakage measurement used a *stereomicroscope at 50 x magnification*. It used a micrometer ruler in millimeter units with an accuracy of 0.1 mm.

This study used univariate analysis with frequency distribution tables and Mann-Whitney Test non-parametric statistical analysis. Univariate analysis was used to get an overview of each variable in this study. Mann-Whitney Test to determine differences in microleakage in each group.

RESULT

The data distribution for the comparison of microleakage resin composite sizes between the bulk-fill technique and the combination of incremental and bulk-fill techniques in class I cavities is presented in the Figure 1.

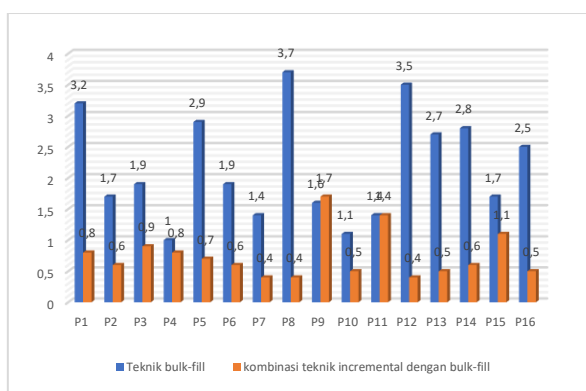


Figure 1. Graph for comparison of the microleakage size of composite resin between the bulk-fill technique and the combination of incremental and bulk-fill

techniques in a class I cavity.

Based on Figure 1, the average microleakage size of composite resin between bulk-fill techniques is greater than the combination of incremental and bulk-fill techniques in class I cavities.

The composite resin's microleakage size significantly differs between the bulk-fill technique and the combination of incremental and bulk techniques in class I cavities.

DISCUSSION

Restoration failure could be affected by the thickness of the material.⁸ In this study, combining bulk and incremental techniques resulted in smaller microleakage than the bulk technique. As is known, this combination technique is carried out in stages. Still, in the first layer, the thickness of the material is not as thin as the incremental technique, referring to the use of bulk-fill composites to build up the core in one layer with a thickness of ± 2.7 mm, then leaving space from the margin for the last layer using conventional composites with a thickness of ± 1.3 mm.⁶ A modification of this technique was suggested in an attempt to simplify the machining step based on the premise that layers in increments may not always be necessary. The rationale behind this method

is that if the composite is placed in a single filling, then an amalgam-like restoration process can be used, also known as the "two-step amalgam-like sculpting technique".⁶

In the bulk and incremental combination technique, the authors use a bulk-fill composite resin material containing short fiber composite reinforced with fiber inside. These fibers could increase flexure strength and fracture resistance and reduce polymerization shrinkage.^{9,11} Fibers theorized to absorb stress-free shock on fiber and resin surfaces. In addition, fiber could replace some parts of the composite, reducing volumetric contraction and shrinkage stress.¹²

Bulk-fill composite resin for bulk technique contains AUDMA monomer (*Aromatic Dimethacrylate*) and AFM (*Addition Fragmentation monomers*). This monomer could reduce the number of reactive resin groups and reduce volumetric shrinkage and matrix stiffness when polymerizing. The first monomer, AUDMA, was able to reduce the number of reactive resin groups and reduce volumetric shrinkage and matrix stiffness during polymerization. The second monomer, AFM, reduces stress to maintain its physical properties. Of the two bulk-fill composites, after distinguishing the restoration technique, the combination technique of

bulk and incremental is superior when compared to the bulk approach because the combination technique of restoration is carried out in stages.^{10,13}

Microleakage in the bulk technique can be affected by polymerization shrinkage, which causes polymerization shrinkage stress on the composite resin.¹ Using an additional layer in the bulk and incremental combination technique helps reduce the pressure caused by the polymerization shrinkage of the composite resin because it reduces the C-factor (cavity configuration factor, the ratio of bonded or unbound surfaces between the cavity and the composite resin).⁶

The bulk-fill technique is popular. After all, processing with a single filling of the restorative material into the cavity and one irradiation is more efficient.⁵ Because the process is short, it causes easy polymerization shrinkage. Polymerization could affect the results of the restorative material and mechanical properties of the effects of filling. The composite resin was not polymerized as a whole.⁵

A study by Giachetti et al. states that the thickness of the thin composite resin restoration material can minimize the polymerization shrinkage stress that occurs.¹⁴ In the combination of bulk and incremental techniques, the composite resin restoration material is thinner when

compared to the bulk technique because the restoration is carried out in stages. The thinner material at the base of the restoration was regular and efficient. Thus, *polymerization shrinkage stress* is distributed well and could reduce stress levels on the edge of the filling area.¹⁵ Less and less the volume of resin involved in the polymerization, the potential for polymerization shrinkage increases small enough to cause stress to build up also smaller.^{16,14} The smaller the polymerization *shrinkage stress* formed, is smaller *microleakage* that happened.¹⁷

Composite resin restoration with a combination of bulk and gradual, incremental techniques and a low C-factor value can minimize polymerization shrinkage, and this causes this combination technique to produce better marginal integrity of the restoration compared to bulk restoration techniques.¹⁸

CONCLUSION

The result was that composite resin restorations combining bulk and incremental techniques produce smaller microleakage than bulk techniques alone.

CONFLICT OF INTEREST

We declare no potential conflict of interest in the scientific articles we write.

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