# Microleakage comparison of Class II restorations with flowable composite as a liner: condensable composites versus universal composite

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## Abstract

*The aim of this in vitro study was to evaluate marginal microleakage of two condensable composites and a traditional universal composite with flowable composite as a lining. Fifteen human molars with no caries and frozen after extraction were chosen for this study. Class II MOD preparations were done. One of the interproximal boxes was terminated in enamel and the other in cementum. The samples were divided in three groups: Group A was restored with ALERT (Jeneric®/Pentron®) condensable composite; Group S was restored with Solitaire (Heraeus-Kulzer) condensable composite and Group Z was restored with Z100 (3M Co.) universal composite. In all restorations, a liner of flowable composite, Flow It! (Jeneric®/Pentron®) was applied. The restorations were finished and stored in deionized water at 37º C for seven days before thermocycling (300 cycles). Finally, the teeth were immersed in 50% silver nitrate solution (two hours) and sectioned for leakage evaluation by three calibrated examiners attributing the following score: (0) no penetration; (1) penetration along the gingival wall; (2) penetration till axial wall; (3) diffusion or penetration into the pulp chamber. RESULTS: The average score of the composites tested was: Group A: enamel= 1.20, cementum= 2.06; Group S: enamel= 2.86, cementum= 2.93; Group Z: enamel= 1.80, cementum= 2.40. All data were subjected to Kruskal-Wallis test, revealing no statistical significance for the results at p< 0.05. CONCLUSIONS: None of the composites systems tested was able to prevent microleakage in both cementum and enamel margins. Group A in enamel presented the minimum average score for microleakage.*

## Uniterms

*Condensable composite, flowable, microleakage*

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## Resumo

O presente estudo objetivou avaliar a microinfiltração marginal de restaurações classe II de duas resinas compostas condensáveis comparando-as com as de uma resina composta universal, utilizando-se uma resina tipo *flow* como forramento. Quinze molares humanos hígidos e congelados após extração foram selecionados para este estudo. Confeccionaram-se cavidades classe II MOD, sendo um dos términos proximais em esmalte e o outro em cemento e dividiram-se os espécimes em três grupos: *Grupo A* foi restaurado com a resina condensável ALERT (Jeneric/Pentron); *Grupo S* foi restaurado com a resina condensável Solitaire (Heraeus-Kulzer) e *Grupo Z* foi restaurado com a resina composta universal Z100 (3M Co.). Como primeira camada (ou forramento), para todos os grupos, fora utilizado a resina de baixa viscosidade Flow it!(Jeneric/Pentron). As restaurações receberam acabamento e os dentes foram então imersos em água destilada a 37ºC por sete dias, precedendo a termociclagem (300 ciclos). Finalmente, os dentes foram mergulhados em solução de nitrato de prata a 50% (duas horas) e seccionados para avaliação da microinfiltração por três

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examinadores calibrados, atribuindo-se os escores: (0) não houve penetração do contraste; (1) penetração na parede gengival; (2) penetração na parede axial; (3) difusão para ou penetração na câmara pulpar. RESULTADOS: As médias escore dos examinadores para os compósitos testados foram: *Grupo A*: esmalte= 1,20, cemento= 2,06, *Grupo S*: esmalte= 2,86, cemento= 2,93, *Grupo Z*: esmalte= 1,80, cemento= 2,40. Submeteu-se aos valores o teste estatístico de Kruskal-Wallis, revelando a não significância estatística entre os grupos para p<0,05. CONCLUSÃO: Nenhum dos compósitos testados foi capaz de impedir a microinfiltração tanto em margens de esmalte como nas de cemento. O grupo A em esmalte apresentou a menor média escore para microinfiltração.

## UNITERMOS

Microinfiltração; resinas condensáveis; resina *flow.*

## INTRODUCTION

Condensable (or packable) composite resins were recently launched in the market aiming to satisfy the clinicians by obtaining more tight proximal contacts, simplifying the operation process and providing an alternative for the high demand of posterior teeth aesthetics.

Is known that composite resins, since their introduction for posterior use – about 30 years ago, have been presenting problems like microleakage, secondary caries and inadequate wear rate[8,13,14]. Consequently, restorations of extended cavities still remain unsafe.

Polymerization contraction is one of the causes of marginal gaps as well as marginal microleakage[5,6,16]. As inevitable, some methods such as incremental technique and soft-start polymerization already were known to at least minimize its unwanted effects.

In recent years, utilization of a flowable composite liner or base has been discussed. It is supposed that the creation of this layer can reduce the polymerization stress of the restorative composite, and also performs other function as a shock-absorber layer.

The purpose of this work was to evaluate marginal microleakage of class II composite resin restorations utilizing a flowable composite as a lining, comparing two condensable composites with a universal one.

## MATERIALS AND METHODOLOGY

Fifteen human molars with no caries were chosen for this study. After extraction, teeth were frozen[2,3,9] in saline solution until the operation process.

Class II MOD preparations were done by means of a high-speed handpiece with adequate water-cooling. One of the interproximal boxes was terminated in enamel and the other in cementum. The samples were divided in three groups: A, S, and Z, and one #245 carbide bur* per group was used.

Group A was restored with ALERT condensable composite, Group S was restored with Solitaire condensable composite and Group Z was restored with Z 100 universal composite. In all restorations were used a flowable composite** lining before placing the restorative composites. The liner thickness was approximately 1mm, placed over the adhesive layer.

Pieces of stainless steel matrix band were burnished and fixed to the teeth with impression compound for better adaptation. For each restorative system, the manufacturer's instructions were followed. A visible-light curing*** unit performing 400-600 mW of potency was used.

After placing the composites, each sample was finished with silicone points occlusally****, and gently at the proximal surfaces with medium Sol-Flex***** disks.

Samples were stored in deionized water at 37ºC for seven days, before thermocycling in baths of 30-second dwell time, at +5ºC/+55ºC, for 300 uninterrupted cycles.

The technique used to contrast the marginal microleakage is basically the same described by Wu & Cobb[18] (1981) and Wu et al.[19] (1983), consisting of the use of a 50% by weight silver nitrate solution.

* Maileffer
** Flow it! (Jeneric/Pentron)
*** Optilux 2 (Gnatus)
**** Viking (KGS)
***** 3M Co.

Previously, teeth root apexes were sealed with Z100/Single bond restorative system. Two coats of nail varnish were applied in all surfaces of the teeth, excepting the restorations and 1mm around of them. In darkness, the samples were soaked in silver nitrate solution for two hours, and then rinsed in tap water to remove solution excess.

The next step consisted in immersion of the samples in a dental developing solution* under a fluorescent light for six hours[12], for reduction and precipitation of silver ions.

The teeth were then washed again in tap water and sectioned mesiodistally/longitudinally by means of a diamond saw*, standardizing three parts for each tooth.

Three calibrated examiners utilizing a stereomicroscope attributed scores, as seen in the Picture 2, based in the part of the tooth with the most extent microleakage, analyzing enamel and cementum margins.

The data was submitted to Kruskal-Wallis statistical test, for $p < 0.05$.

## Results

The average score of microleakage attributed by the examiners is showed in the following:

Group A showed the minimum average score for microleakage in both cementum and enamel margins compared to the rest of the groups. It has been verified that the cementum values were always higher than the enamel values for all groups. However, there was no statistically significant difference among the groups.

**Picture 1 - Composites tested and respective adhesives and manufacturers**

| Composite | Adhesive | Manufacturer |
|---|---|---|
| ALERT | Bond 1 | Jeneric/Pentron |
| Solitaire | Solid Bond | Heraeus-Kulzer |
| Z 100 | Single Bond | 3M |

**Picture 2 - Scores for both cementum and enamel margins**

| | |
|---|---|
| **0** | no penetration |
| **1** | penetration along the gingival wall |
| **2** | penetration until axial wall |
| **3** | diffusion or/and penetration into the pulp chamber |

**Picture 3 - Examiner's average microleakage scores**

| | ENAMEL | CEMENTUM |
|---|---|---|
| GROUP A | 1,20 | 2,06 |
| GROUP S | 2,86 | 2,93 |
| GROUP Z | 1,80 | 2,40 |

* Kodak
** Labcut 1010 (Extec)

## Discussion

According to the results obtained in this work we observe minimum average score for microleakage for group A in enamel. In cementum margins also similar results among the groups and higher microleakage values if compared to enamel margins.

Microleakage of composite resin restorations occurs due to gap formation between restorative material and the tooth structure, or between the restorative materials. It is a common phenomenon and is hard to avoid because several factors are involved and is not dependent only on the composite or the adhesive performance. These factors could be the technique sensitive, operator ability, substrate quality (dentin), etc. For the restorative materials, we can relate basically factors like coefficient of thermal expansion, hydrolytic degradation and polymerization contraction. This last maybe is the major drawback that we confront and can only be compensated in part by the posterior hygroscopic expansion of the composite[5].

The objective of using a liner of flowable composite or just increase the number of layers of adhesive was described by some authors like Van Meerbeek[*] (1994), Carvalho et al.[4,5] (1996, 1998) and Christensen[7] (1997). The justification is, in fact, to create an elastic layer that can work like a shock absorber layer, and thus to help compensate the polymerization contraction stresses of the restorative composite. Otherwise, Bayne et al.[1] (1998) reported that a flowable composite should be expected to shrink more and create more stress on bonding agents during composite curing than traditional composite. The relative importance of each one of these parameters must be carefully investigated by further studies.

Ferdianakis[11] (1998), in a microleakage study, encountered significant reduction on microleakage for class I flowable composite restorations compared to conventional composite ones. Tung et al.[17] (2000), comparing ALERT, condensable composite, with and without a liner of flowable composite, also found significant reduction on microleakage by 0.2% basic fuchsin for the group with lining. These findings indicate that a flowable composite liner could minimize the stress concerning to polymerization contraction of the restorative composite.

Darbyshire et al.[9] (1988) et al. reported that the silver–staining technique of microleakage assessment used in this study gives a discrete, high-contrast marking of the restoration-dentin interface, and Yu et al.[20] (1992) emphasized that other dye penetration methods used frequently, such as methylene blue, basic fuchsin, China ink, etc. only give us gross information. Paul et al.[15] (1999) describes silver-nitrate contrast method for microleakage as an excellent, tracer, as the silver ions are very small, and due to their high solubility, highly concentrated solutions can be prepared.

Posterior condensable composite resins arouse in the market aiming to present better performance than the others. Their propaganda is based in high filler content, modified organic matrix and low polymerization contraction. In this study, ALERT - condensable composite with a flowable composite lining technique, apparently showed better performance compared to the work of Cilli & Araújo[8] (2000), where ALERT class II restorations with no liner were performed. However, Z100 - universal composite, showed a discrete inferior performance with flowable lining. Solitaire restorations presented high values of microleakage both in cementum and enamel margins, idem to Cilli & Araújo[8] (2000) study.

These values can be useful to predict the performance of the materials used; however, further studies are necessary to establish a consensus.

Until no contraction composites be developed, all necessary cares to obtain the most perfect adhesion[4] and to reduce the problems concerning cavitary configuration factor (C factor)[5] must be taken.

* VAN MEERBEEK, B. DENTINE bonding systems. apud SMITH, D. C.; VANHERLE, G. State of the art of direct posterior fillingmaterials and dentine bonding. **J. Dent.,** v. 22, p. 121-4, 1994. (Sumary of an international symposium).

## Conclusion

a) none of the groups tested was able to prevent microleakage;

b) apparently Group A showed better performance than the others, however there was no statistical significant difference among the groups;

c) levels of microleakage in cementum were higher than enamel for all groups.

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## References

1. BAYNE, S et al.. A characterization of first-generation flowable composites. **J Am Dent Assoc**, v. 129, p. 567-77, May 1998.

2. BRÄNNSTRÖM, M.; COLI, P.; BLIXT, M.. Effect of tooth storage and cavity cleansing on cervical gap formation in class II glass-ionomer/composite restorations. **Dent Mater**, v. 8, n. 5, p. 327-31, Sept. 1992.

3. CAMPS, J. et al. Influence of tooth cryopreservation and storage time on microleakage. **Dent Mater**, v. 12, n. 2, p. 121-6, Mar. 1996.

4. CARVALHO, R. M.. Adesivos dentinários: fundamentos para aplicação clínica. **Rev Dent Rest**, v. 1, n. 2, 1998.

5. CARVALHO, R. M. et al., A review of polymerization contraction. The influence of stress development versus stress relief. **Oper Dent**, v. 21, n. 1, p. 17-22, 1996.

6. CASTELNUOVO, J; TJAN, A. H. L.; LIU, P.. Microleakage of multi-step and simplified-step bonding systems. **Am J Dent**, v.9, n.6, p. 245-8, dec. 1996.

7. CHRISTENSEN, G. J., Tooth colored posterior restorations, 1997. **Oper Dent**, v. 22, n. 4, p. 146-8, 1997.

8. CILLI, R.; ARAÚJO, M. A. J.. Resinas compostas condensáveis: estudo de microinfiltração. **Pós-Grad Rev Fac Odont São José dos Campos**, v. 3, n.1, jan./jul. 2000.

9. DARBYSHIRE, P. A.; MESSER, L. B.; DOUGLAS, W. H.. Microleakage in class II composite restorations bonded to dentin using thermal and load cycling. **J Dent Res**, v. 67, n. 3, p. 585-7, Mar. 1988.

10. DERHAMI, K.; COLI, P.; BRÄNNSTRÖM, M.. Microleakage in class 2 composite resin restorations. **Oper Dent**, v. 20, n. 3, p. 100-5, 1995.

11. FERDIANAKIS, K.. Microleakage reduction from newer esthetic restorative materials in permanent molars. **J Clin Ped Dent**, v. 22, n. 3, p. 221-9, 1998.

12. HASEGAWA, E. A. et al. Microleakage of indirect composite inlays. **Dent Mater**, v. 5, n. 6, p. 388-91, Nov. 1989.

13. LEINFELDER, K. F.. Posterior composite resins: the materials and their clinical performance. **J Am Dent Assoc**, v. 126, n. 5, p. 663-76, May 1995.

14. LEINFELDER, K. F. A report on a new condensable composite resin. **Compendium**, v. 19, n. 3, p. 230-7, Mar. 1998.

15. PAUL, S. J. et al. Nanoleakage at the dentin adhesive interface vs μ-tensile bond strenght. **Oper Dent**, v. 24, p. 181-8, 1999.

16. PRATI, C. et al. Permeability and microleakage of class II resin composite restorations. **J Dent**, v. 22, n. 1, p. 49-56, 1994.

17. TUNG, F.; ESTAFAN, D.; HSIEH, W.. In vitro microleakage study of a condensable and flowable composite. **J Dent Res**, v. 79, sp. iss., p.183, 2000. (Abstract 314).

18. WU, W.; COBB, E. N.. A silver staining technique for investigating wear of restorative dental composites. **J Biomed Mater Res**, v. 15, n. 3, p. 343-8, 1981.

19. WU, W.; COBB, E.; DERMANN, K.. Detecting margin leakage of dental composite restorations. **J Biomed Mater Res**, v. 17, n. 1, p. 37-43, 1983.

20. YU, X. Y. et al. Origination and progression of microleakage in a restoration with a smear layer-mediated dentinal bonding agent. **Quintessence Int**, v. 23, n. 8, p. 551-5,1992