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ORIGINAL RESEARCH

The Effect of Flowable Composite Lining Thickness with Various Curing Techniques on Microleakage in Class II Composite Restorations: An *in vitro* Study

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ABSTRACT

Aim: Aim of this study was to compare class II composite restoration using flowable composites as lining with various thickness and curing techniques by evaluating cervical marginal microleakage.

Materials and methods: Fifty intact molars, each prepared with two box-only class II cavities, were randomly divided into five groups: Group I, P60 filling alone; group II, ultrathin flowable composite lining (0.5-1mm) cocured with overlying composite; group III, thin lining (1-1.5) cocured with overlying composite; group IV, ultrathin lining (0.5-1 mm) precured and group V, thin lining (1-1.5) precured. The teeth were then thermocycled for 1500 cycles (between 5 and 60 ºC) and immersed in dye for 24 hours. Cervical microleakage was measured as the extent of dye penetration.

Results: Cocured specimens (groups II and III) showed least microleakage and control specimens (group I) showed maximum microleakage. On comparison of curing techniques, cocured specimens (groups II and III) showed less microleakage than precured (groups IV and V). On comparison of lining thickness and type of curing, group IV showed less microleakage than group V. Groups II and III were statistically not significant.

Conclusion: It was concluded from the results that ultrathin cocured flowable composite lining specimens improved the marginal sealing with decreased microleakage.

Clinical significance: In this study, the application of additional flowable composite lining with various thicknesses presented different influences in marginal quality of class II box only composite restorations. A new technique applying an ultrathin flowable composite lining with cocuring technique improved the marginal sealing with decreased microleakage. Restorations with thin lining presented reduced marginal integrity after thermocycling.

Keywords: Packable composite, Flowable composite, Precure technique, Co-cure technique, Ultrathin lining and thin lining.

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INTRODUCTION

To improve the marginal sealing, various incremental techniques, curing techniques and lining materials have been designed.[1] Flowable composites are nonsticky and injectable due to lower filler content.[2] The use of flowable composite as a liner provided reduction in microleakage.[3] Recently a new technique was introduced where a thin layer of flowable composite is applied to cavity floor which is immediately followed by packable composite increment and light cured which offers the advantage of intimate adaptation of filling.[4] Accordingly this study evaluated microleakage using flowable composite lining with the modified incremental technique and with various lining thicknesses.

MATERIALS AND METHODS

Freshly extracted fifty human molars were mounted on dental stone with one premolar and one molar on the mesial and distal sides to simulate posterior tooth alignment and were prepared with standardized mesio-occlusal and disto occlusal box only class II cavities having buccolingual width 4 mm, mesiodistal width 2 mm and occlusogingival depth of 3 mm (Fig. 1). Sectional matrix band was placed which was stabilized with G-rings and wooden wedges. They were etched with 35% phosphoric acid, washed thoroughly with water for 15 seconds and followed by the application of the two layers of single bond and each layer was cured with curing light for 10 seconds. The 50 molar teeth were randomly divided into 5 groups of 10 teeth each. Group I: Cavity preparations were restored with posterior composite alone, i.e. P60, group II: Cavity preparations were lined with flowable composite (Filtek flow) to about 0.5-1 mm

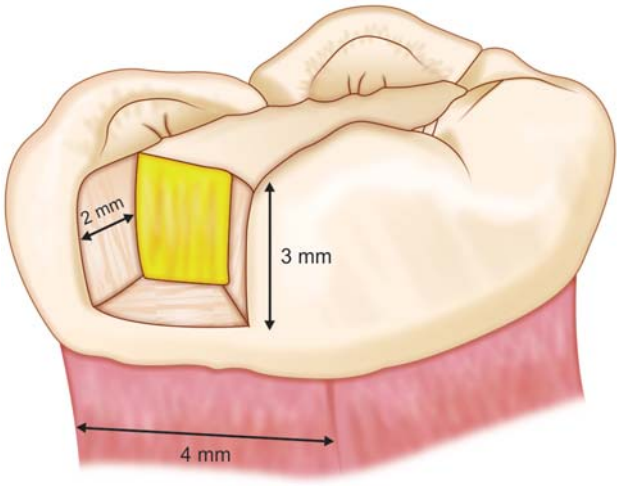


Fig. 1: Schematic representation of class II box—only cavity preparation

occlusogingival thickness, then 1 mm thick posterior composite (P60) was inserted immediately and cured together (cocured), group III: It was similar to group II except lining thickness was 1 to 1.5 mm, group IV: Cavity preparations were lined with ultrathin layer of flowable composite, i.e. 0.5 to 1 mm and cured for 20 seconds (precured). Remaining cavity was filled with posterior composite, group V: It was similar to group IV except lining thickness was 1 to 1.5 mm. The restorations were cured via buccal and lingual aspects for 20 seconds, placed in isotonic saline at 37ºC for 24 hours and thermocycled for 1500 cycles between 5°C and 60°C with the dwelling time of 20 seconds for each temperature.

The root apices of the specimens were sealed with wax, and all the surfaces were coated with two layers of nail varnish from 1mm beyond the restorations. Specimens were then soaked in 1% basic fuchsin dye in a 37°C water bath for 24 hours. They were mesiodistally sectioned using a hard tissue microtome and were examined under a 50× stereomicroscope (Fig. 2). Cervical marginal microleakage was recorded as: Score 0 = no dye penetration, score 1 = dye penetration limited to enamel (Fig. 3), score 2 = dye penetration beyond dentinoenamel junction, but limited to 2/3rd of cervical wall length (Fig. 4), score 3 = dye penetration beyond 2/3rd of cervical wall length, but not to the pulpal wall (Fig. 5), score 4 = dye penetration to the pulpal wall (Fig. 6). One-way ANOVA was used for checking the difference in the pattern of microleakage scores. Group-wise comparisons are made by Mann-Whitney test. Categorical data are analyzed by Chi-square test. For all the tests a p-value of 0.05 or less was considered for statistical significance.

RESULTS

Cocured specimens (groups II and III) showed least microleakage and control specimens (group I) showed maximum microleakage. On comparison of curing techniques, cocured specimens (groups II and III) showed less microleakage than precured (groups IV and V). On comparison of lining thickness and type of curing,

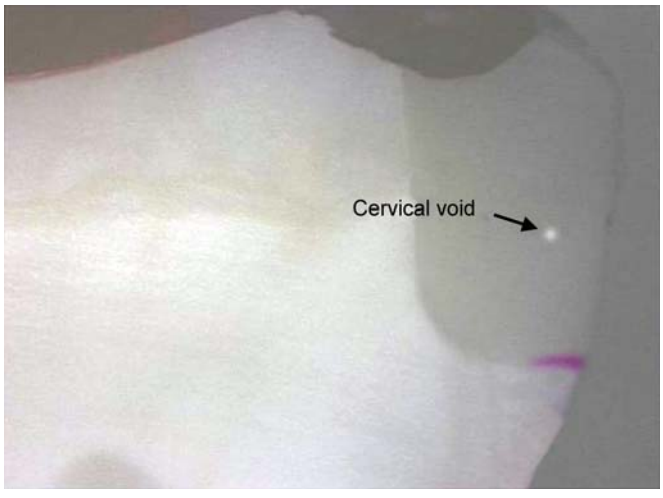


Fig. 3: Specimens showing leakage limited to enamel (score: 1)

Fig. 2: Specimens after sectioning with microtome

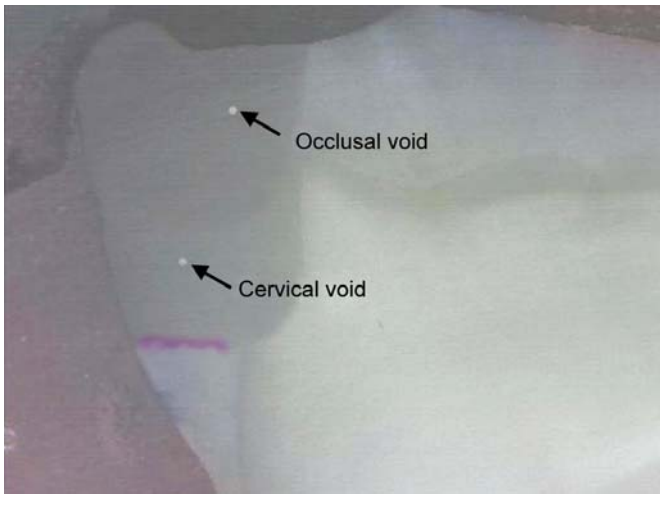


Fig. 4: Specimens showing leakage beyond DEJ but limited to 2/3 of cervical wall length (score: 2)

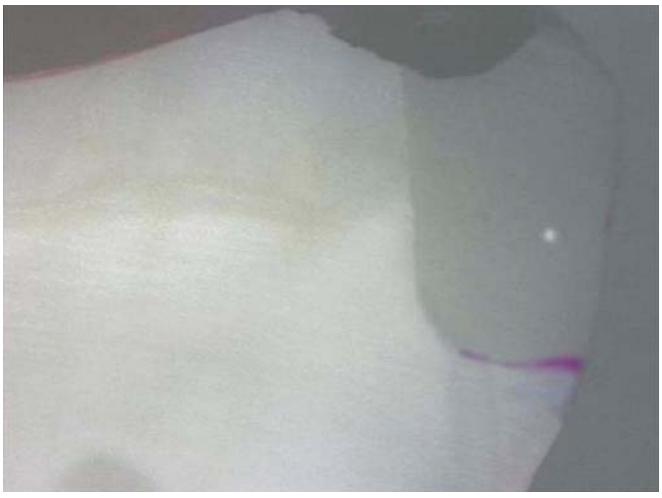


Fig. 5: Specimens showing leakage beyond 2/3 of cervical wall length (score: 3)

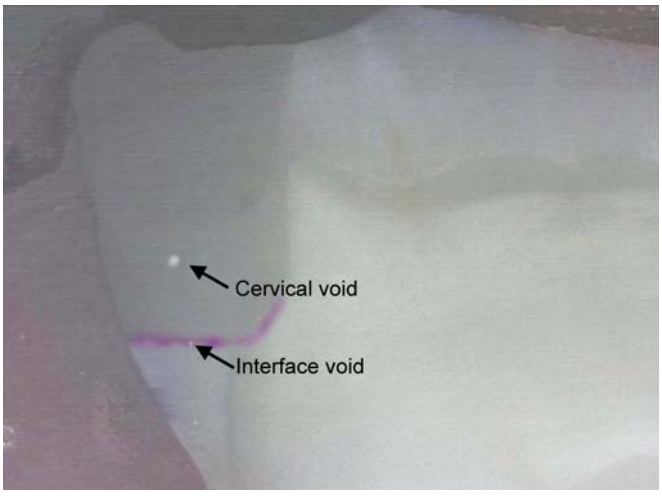


Fig. 6: Specimens showing leakage till pulpal wall (score: 4)

group IV showed less microleakage than group V. Groups II and III were statistically not significant (Table 1).

DISCUSSION

The major problem associated with class II composite resin restorations is microleakage at the cavosurface margin of the proximal box.[5] The effect of flowable composite materials on microleakage of class II composite restorations that extend apical to CEJ reduced microleakage.[6] To improve marginal sealing and reduce microleakage many clinical techniques like incremental techniques, various light curing techniques, low modulus lining materials were introduced. New materials, such as flowable resin composites were introduced in late 1996 and are continually being developed to improve handling characteristics like non-stickiness and fluid injectability.[2] A study evaluated that the use of flowable resin composite beneath a condensable resin composite significantly reduced microleakage.[7] A study evaluated that the use of flowable resin composite beneath a nanofilled and hybrid class II composite significantly improved marginal seal.[8]

A study evaluated microleakage with and without flowable liners and concluded that; flowable composites reduced, but did not eliminate microleakage at the gingival cavosurface margins apical to CEJ.[9] A study suggested that there will be reduction of contraction, stress reduction and the maintenance of marginal integrity in thin resin layers.[10] A study has recommended the use of flowable composite as a first increment in deep class II cavities.[11] To reduce the microleakage, newer material placement techniques were used. The flowable composites are used as a liner and cured, over which the final packable composite is placed and cured incrementally which was suggested as a precured method of placement.[4] Now recently, in a new technique called co-cured technique, a thin layer of flowable composite is applied to the cavity floor which is immediately followed

Table 1: Cervical marginal microleakage rating

Groups	*Total no. of specimens*	*Microleakage score*					*Mean score ± SD*	*Median score*
		0	*1*	*2*	*3*	*4*		
Gr. I	40	2 (5)	10 (25)	18 (45)	7 (17.5)	3 (7.5)	2.0 ± 1.0	2
Gr. II	40	14 (35)	22 (55)	4 (10)	-	-	0.8 ± 0.6	1
Gr. III	40	15 (37.5)	23 (62.5)	12 (30)	1(2.5)	-	1.3 ± 0.6	1
Gr. IV	40	7 (17.5)	25 (62.5)	7 (17.5)	1 (2.5)	-	1.1 ± 0.7	1
Gr. V	40	5 (12.5)	19 (47.5)	9 (22.5)	4 (10)	3 (7.5)	1.5 ± 1.1	1
Gr. I-II		p < 0.001, HS						
Gr. I-III		p < 0.001, HS						
Gr. I-IV		p < 0.001, HS						
Gr. I-V		p < 0.05, S						
Gr. II-III		p = 0.63, NS						
Gr. II-IV		p < 0.05, S						
Gr. II-V		p < 0.01, S						
Gr. III-IV		p < 0.05, S						
Gr. III-V		p < 0.001, HS						
Gr. IV-V		p < 0.05, S						

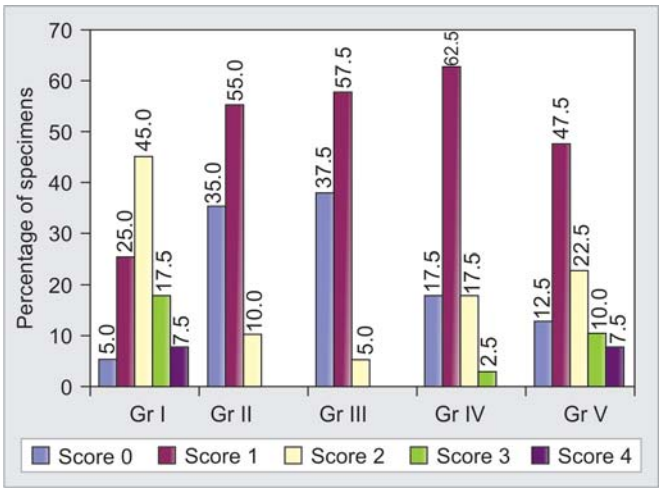
Mann-Whitney test
ANOVA F = 18.2; p < 0.01, S: Significant; HS: Highly significant; NS: Non significant

by packable composite increment and then light cured together. This technique offers the advantage of intimate adaptation of filling and improved handling properties.[4] The present study was conducted to compare class II composite restoration using flowable composites as lining with various thickness and curing techniques by evaluating cervical marginal microleakage.

The results of the present study showed that group II displayed the best interface marginal quality, when compared with group V (Graph 1). Higher polymerization shrinkage with flowable composite was seen than their hybrid analogs. Marginal microleakage increased with the increasing thickness of flowable composite lining which is due to increasing the proportion of monomer resulting in high polymerization shrinkage values.[12] It is concluded that flowable composite lining should be kept as thin as possible to reduce microleakage.

The results of the present study showed that marginal microleakage was lesser in cocured teeth than in precured teeth (Table 1). In a study light active glass ionomer cement was cocured with composite resin restoration showed that the lesser polymerization shrinkage was encountered which was due to the fact that dimensional changes caused by resin could be taken up by the glass ionomer cement eliminating many of the internal stresses and hence reducing the marginal leakage.[13] Another study has recommended that a flowable composite can be injected over the internal surfaces of the preparation to a thickness ranging from 0.5 to 1.0 mm. This study further explains that as the overlying packable composite undergoes polymerization shrinkage, the adjacent flowable composite stretches or elongates, acting as a stress-breaker.[10] On the same principles, it can be assumed that cocuring of flowable and packable composites would also yield lesser polymerization shrinkage and subsequent microleakage as suggested by the present study. A number of studies have suggested that the flowable composite lining favorably improves the marginal sealing.[9]

From the results of the present study, it can be concluded that there was an improved cervical marginal seal by combining packable (P60) and an ultrathin flowable lining of 0.5 to 1 mm (Filtek flow). It was also adequately proved that cocured showed better marginal adaptation than precured flowable lining composite restorations.



Graph 1: Cervical marginal microleakage pattern

CONCLUSION

An ultrathin lining of flowable composite at the base of the cavity followed by cocuring technique of both flowable and packable composite showed the least cervical marginal microleakage and thus the best marginal adaptation.

CLINICAL SIGNIFICANCE

In this study, the application of additional flowable composite lining with various thicknesses presented different influences in marginal quality of class II box only composite restorations. A new technique applying an ultrathin flowable composite lining with cocuring technique improved the marginal sealing with decreased microleakage. Restorations with thin lining presented reduced marginal integrity after thermocycling.

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