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THE EFFECT OF FLOWABLE COMPOSITE LINING THICKNESS WITH VARIOUS CURING TECHNIQUES ON INTERNAL VOIDS IN CLASS II COMPOSITE RESTORATIONS -AN INVITRO STUDY.

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ABSTRACT:
Aim of this study was to compare class II composite restoration using flowable composites as lining with various thickness and curing techniques by evaluating internal voids. Fifty intact molars, each prepared with two box-only class II cavities, were randomly divided into five groups: Group I, P 60 filling alone; Group II, ultra thin flowable composite lining (0.5-1mm) co-cured with overlying composite; Group III, thin lining (1-1.5) co-cured with overlying composite; Group IV, ultra thin lining (0.5-1mm) precured and Group V, thin lining (1-1.5) precured. Internal voids were recorded in the gingival interface, cervical and occlusal halves of restorations. Precured techniques for flowable composite lining showed the least number of interface and cervical voids where as the co-cured technique of flowable and packable composites showed the least number of occlusal voids.

KEY WORDS: Packable composite; flowable composite; precure technique; co-cure technique; ultra thin lining and thin lining.

INTRODUCTION

Packable composite was developed by changing the filler or matrix phase to increase viscosity for better condensation similar to that of amalgam[1]. However ability to adequately adapt the internal areas was always questionable[2]. So in an attempt to reduce the voids, various incremental techniques, curing techniques and lining materials have been designed[1]. Flowable composites were introduced in late 1996. They are non-sticky and injectable. They have low viscosity and increased wettability due to lower filler content[3]. Flowable composite as a lining material for class II resin composites reduced voids[4]. Considering the advantages and disadvantages of various types of composites and techniques, recently a new technique was introduced by Jackson and Morgan 2000 where a thin layer of flowable composite is applied to cavity floor which is immediately followed by packable composite increment and light cured. Most of flowable composite is expelled while placing overlying composite and its volume will be minimized. This technique offers the advantage of two different composites including intimate adaptation of filling and handling properties[5]. Accordingly this invitro study compared class II composite restorations using flowable composite lining either with the modified incremental technique or with various thicknesses by evaluating internal voids.

Methodology

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 bucco-lingual width 4 mm, mesio distal width 2mm and occluso gingival depth of 3 mm. 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.P_{60}, **Group II:** Cavity preparations were lined with flowable composite (Filtek flow) to about 0.5-1mm occluso gingival thickness, then 1mm thick posterior composite (P_{60}) was inserted immediately and cured together (co cured), **Group III:** It was similar to group II except lining thickness was 1-1.5mm, **Group IV:** Cavity preparations were lined with ultra thin layer of flowable composite i.e. 0.5-1mm and cured for 20 seconds (precured). Remaining cavity was filled with posterior composite, **Group V:** It was similar to

Table.1 Interface voids rating

Groups	No.	Interface	
		Voids -	Voids +
Gr. I	40	21 (52.5)	19 (47.5)
Gr. II	40	34 (85)	6 (15)
Gr. III	40	32 (80)	8 (20)
Gr. IV	40	40 (100)	0
Gr. V	40	40 (100)	0
Comparison between groups	Gr. I-II	χ^2 = 9.83	P = 0.01, S
	Gr. I-III	χ^2 = 6.77	P = 0.01, S
	Gr. I-IV	χ^2 = 24.91	P = 0.001, HS
	Gr. I-V	χ^2 = 24.91	P = 0.001, HS
	Gr. II-III	χ^2 = 0.35	P = 0.56, NS
	Gr. II-IV	χ^2 = 6.49	P = 0.05, S
	Gr. II-V	χ^2 = 6.49	P = 0.05, S
	Gr. III-IV	χ^2 = 8.89	P = 0.01, S
	Gr. III-V	χ^2 = 8.89	P = 0.01, S
	Gr. IV-V	χ^2 = 0.00	P = 1.00, NS

Graph.1. Interface voids pattern

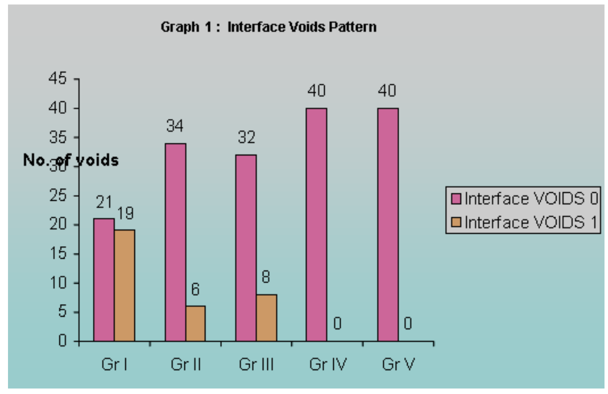


Table.2 cervical voids rating

Groups	No.	Cervical	
		Voids -	Voids +
Gr. I	40	4 (10)	36 (90)
Gr. II	40	10 (2.5)	30 (75)
Gr. III	40	8 (20)	32 (80)
Gr. IV	40	13 (32.5)	27 (67.5)
Gr. V	40	18 (45)	22 (55)
Comparison between groups	Gr. I-II	χ^2 = 3.11	P = 0.08, NS
	Gr. I-III	χ^2 = 1.57	P = 0.21, NS
	Gr. I-IV	χ^2 = 6.05	P = 0.05, S
	Gr. I-V	χ^2 = 12.3	P = < 0.05, S
	Gr. II-III	χ^2 = 0.29	P = 0.59, NS
	Gr. II-IV	χ^2 = 0.55	P = 0.46, NS
	Gr. II-V	χ^2 = 3.52	P = 0.06, NS
	Gr. III-IV	χ^2 = 1.61	P = 0.20, NS
	Gr. III-V	χ^2 = 5.70	P = 0.05, S
	Gr. IV-V	χ^2 = 1.32	P = 0.25, NS

Graph.2. Cervical voids pattern

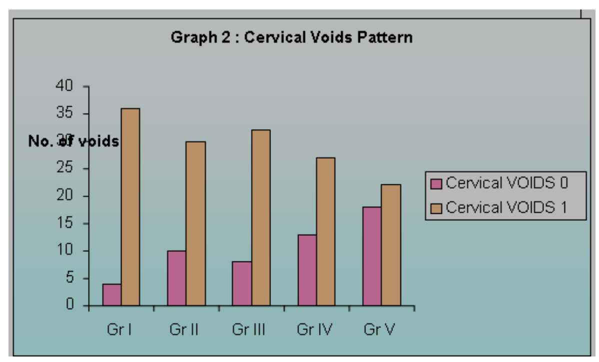
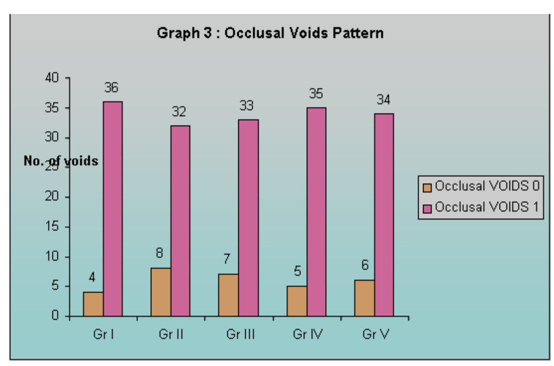


Table.3 . Occlusal voids rating

Groups	No.	Occlusal	
		Voids -	Voids +
Gr. I	40	4 (10)	36 (90)
Gr. II	40	8 (20)	32 (80)
Gr. III	40	7 (17.5)	33 (82.5)
Gr. IV	40	5 (12.5)	35 (87.5)
Gr. V	40	6 (15)	34 (85)
Comparison between groups	Gr. I-II	χ^2 = 1.57	P = 0.21, NS
	Gr. I-III	χ^2 = 0.95	P = 0.33, NS
	Gr. I-IV	χ^2 = 0.13	P = 0.72, NS
	Gr. I-V	χ^2 = 0.46	P = 0.50, NS
	Gr. II-III	χ^2 = 0.08	P = 0.77, NS
	Gr. II-IV	χ^2 = 0.83	P = 0.36, NS
	Gr. II-V	χ^2 = 0.35	P = 0.56, NS
	Gr. III-IV	χ^2 = 0.39	P = 0.53, NS
	Gr. III-V	χ^2 = 0.09	P = 0.76, NS
	Gr. IV-V	χ^2 = 0.10	P = 0.74, NS

Graph.3. Occlusal voids pattern



group IV except lining thickness was 1-1.5mm. The restorations were cured via buccal and lingual aspects for 20 seconds. They were mesio-distally sectioned using a hard tissue microtome and were examined under a 50x stereomicroscope. In Internal voids evaluation voids were seen in three sites - Occlusal half of restorations, Cervical half of restorations, Gingival interface (restorative interface of cervical margin). Voids were scored as follows: No voids = 0, Visible voids = 1. 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:

Precured specimens showed less number of voids and control specimens showed maximum number of voids. In interface and cervical half on comparison of curing techniques, precured specimens showed less number of voids than co-cured specimens. **(Table–I and Table II**). In occlusal half on comparison of curing techniques, co-cured specimens showed less number of voids than precured specimens. **(Table–III)**. In interface and cervical half on comparison of lining thickness and type of curing, Group IV showed less number of voids than Group V. (Table – 2). In occlusal half on comparison of lining thickness and type of curing, Group V showed less number of voids than Group IV. Group II showed less number of voids than Group III in interface and occlusal half. **(Graph-1 and 3)** Group III showed less number of voids than Group II in cervical half. **(Graph-2).**

Discussion

With increased patient interest in esthetic alternatives to dental amalgam, the objectives were to modify the handling characteristics of RBC[4]. Voids are usually produced by the air trapped during mixing or application procedures. It is based on free radical polymerization and contains redox system which promotes bulk polymerization inhibition due to high chemical affinity of atmospheric oxygen for free radicals. It creates surface discontinuities, which increases fracture propagation and failure on loading. Poor marginal adaptation is related to internal voids. Larger voids will reduce the mechanical strength of restoration[6]. To reduce the internal voids, 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[5]. A study conducted to evaluate the effect of flowable composite lining on microleakage and internal voids in class II composite restorations revealed few cervical voids in flowable lining restorations[7]. 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 by packable composite increment and then light cured together. This technique offers the advantage of intimate adaptation of filling and improved handling properties[5]. The present study was conducted to compare class II composite restoration using flowable composites as lining with various thickness and curing techniques by evaluating the internal voids.

The result of the present study reveals that internal voids predominantly consisted of interface and cervical voids **(Table–I and Table II**). Group I showed high prevalence of interface and cervical voids **(Graph-1 & 2)** . The presence of such voids may contribute to deficient cavity adaptation and unavoidable trapping of air while manipulating a posterior composite. Group II results indicated that the incidence of interface and cervical voids decreased when compared to Group I, with the application of flowable linings, but remained higher than the precured groups (Group-IV&V). The results of the present study are in agreement with a study conducted to evaluate the microleakage and internal voids in class II composite restorations with flowable composite lining (precured) showed a reduction in the number of voids as compared to those in which flowable lining was used[6].Packing the composite may cause incorporation of air. A study conducted to evaluate the incidence of interface voids and microleakage of class II box only composite restoration with ultra thin flowable resin lining showed moderate incidence of interface voids[5]. A study conducted to evaluate effect of flowable resin composite on microleakage and interface voids in class II composite restorations revealed reduced interface voids and total number of voids were reduced in restoration[8] .This is due to enhanced cavity adaptation, low modulus of elasticity, increased wetting of flowable composites and there by leading to lesser number of voids[4].

The results of the present study are in agreement with another study which evaluated shrinkage stress reduction on porosity concentration in thin resin layers. This study demonstrated that reduced contraction stresses could be obtained by using a thin, pore containing lining material. Both the presence of minimal voids and setting inhibition effect caused by the oxygen present in these voids could provide relief polymerization stress and result in reduced microleakage. The study also suggests that care must be taken not to trap air during placement of flowable composite. The repeated packing motion following placement of overlying composite must be avoided to prevent undue porosity formation[9].

From the results of the present study it can be concluded that the co-cured flowable lining composite restorations showed greater internal voids when compared to precured flowable lining composite restoration.

CONCLUSION

An ultra thin lining of flowable composite at the base of the cavity followed by precuring technique and then the incremental build up of packable composite showed the least number of interface voids. A thin lining of flowable

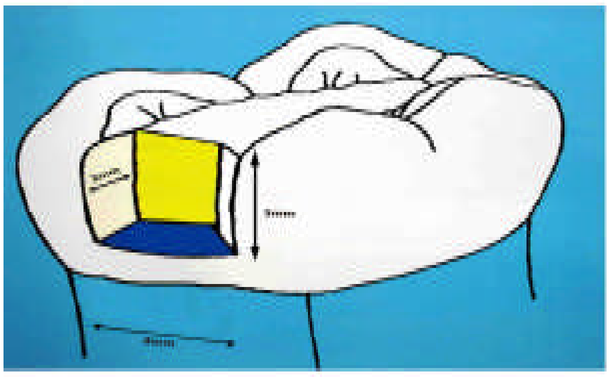


Fig.1. Schematic representation of class II box only cavity preparation

Fig.3. Class II box preparation (MO and DO)

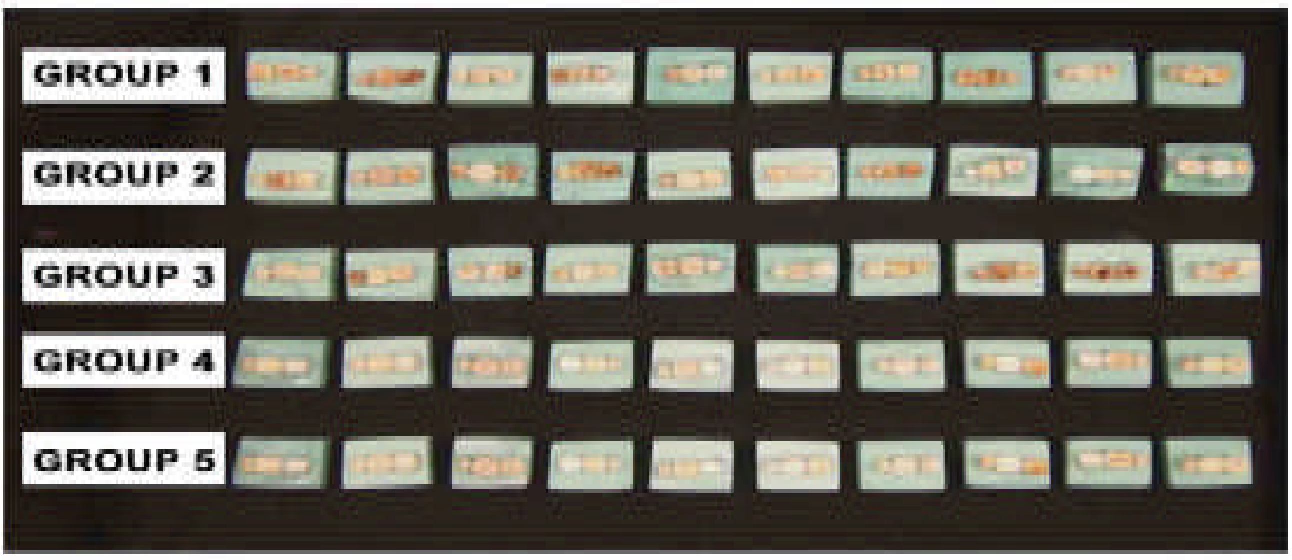


Fig.2. Specimens used in the study

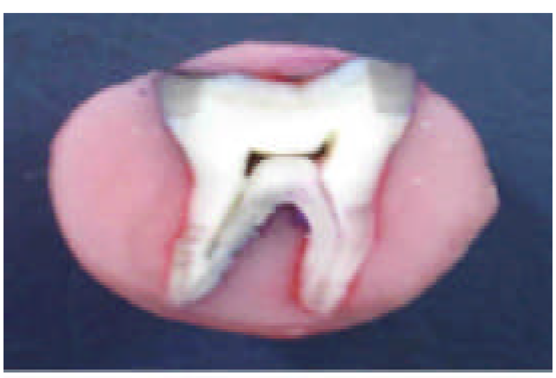


Fig.4. Specimen after sectioning with microtome

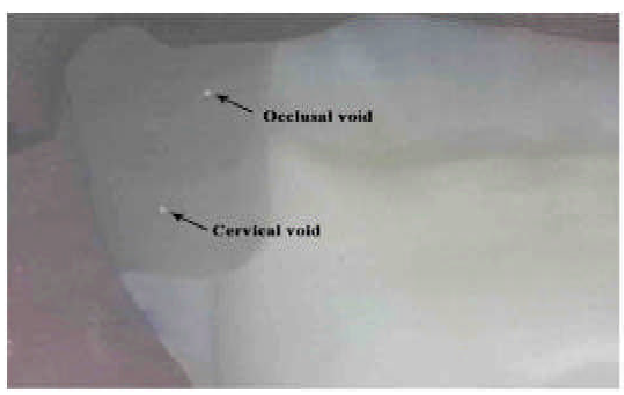


Fig.5. Specimen showing internal voids

composite at the base of the cavity followed by precuring technique and then the incremental build up of packable composite showed the least number of cervical voids. An ultra thin lining of flowable composite at the base of the cavity followed by co-curing technique of both the flowable and packable composite showed the least number of occlusal voids.

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