The Influence of Different Filling Materials and Techniques on the Microleakage of Cervicle and Occlusal Margins in CLII Cavities

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Abstract:

Esthetic filling is the preference of population but because of the immediate sensitivity and late color change that is related to the microleakage, many new techniques and material used to overcome and improve these shortcomings

Aim: *The aim of this study is to evaluate and compare microleakage at occlusal wall and cervicle wall in proximal cavities restored with bulkfill and bulkflowable +universal composite*

Material and method: *20 freshly extracted teeth were divided into 2 groups of 10 teeth each.standared clII cavities were made on mesial surface of each tooth and restored with(bulkfill) and(bulkflowable with z350xt) ,after storage and thermocycling and immersion in dye. Specimen were sectioned and evaluated for micrleakage at occlusal and cervicle wall using electric microscope*

Statistical analysis: *Using : mean , median, standard deviation with the min. and max. Using student t- test and mann whitney t-test were done*

Result: *The results showed that in the occlusal wall and cervicle wall, bulk fill composite shows significantly less marginal microleakage than bulkflowable and universal composite.*

Conclusion: *Based on the result of this study bulkfill composite showed less microleakage than bulkflowable in both the cervical region and occlusal region*

Keywords: Bulk fill composite, ClII restoration, marginal microleakage, bulkflowable

تأثير انواع الحشوات الختلفه والتقنيات المختلفه على المايكرو ليك في منطقتي الاطباق والمنطقه اللثويه من حشوه نوع CLII

المستخلص: الهدف من هذه الدراسة هو تقييم ومقارنة الميكروليالك في جدار الإطباق وجدار المنطقه اللثويه والتي تم عمل حشوه لها بطريقه البلك فل وال يونيفيرسل كمبوزت

المواد وطريقة العمل: تم تقسيم 20 من الأسنان المستخلصة طازجًا إلى مجموعتين من 10 أسنان لكل منها. تم تصنيع تجاويف CLII على السطح الخاص لكل سن وتمت تحشيه كل مجموعه بطريقه خاصه وعلى اساسها قسمت الاسنان الى مجموعتين المجموعه الاولى تمت تحشيتها باستخدام البلك فل والمجموعه الثانيه باستخدام ال بلك فلوبل z350xt ، بعد ذلك تم التخزين والتدجين الحراري والغطس في الصبغ

قسمت العينة وتم تقييمها من أجل micrleakage في جهه الاطباق وجهه اللثه من ال CLII العنقي باستخدام المجهر الكهربائي
التحليل الإحصائي: متوسط الانحراف، الانحراف المعياري مع الحد الأدنى. و ماكس تم أيضا اختبار قيمة p و mann whitney و t-test

النتائج: تظهر النتائج أنه كميه المايكرو ليك باستخدام البلك فل اقل منه بماده ال Z350XT
الاستنتاج: استناداً إلى نتائج هذه الدراسة، اثبتت فاعلية ماده البلك فل وتفوقها على المواد الاخرى من ناحيه الماكروليك
الكلمات المفتاحية: ملء مجمع المركب، cl الثاني الترميم، microleakage هامشية، bulkflowable

Introduction

Composite restoration is the most popular types of fillings that perform the demand of esthetics but the big challenge is its performing correctly without any problem in sealing its margins specially in posterior cl II restoration [1], that may lead to serious problems in the final result starting from sensitivity that happen because of the passage of fluids and bacteria between the restoration and the tooth structure which will lead to recurrent caries and ending with pulp inflammation and tooth damage .[2,3]

This sensitivity and microlekage is may be due to debonding of the filling material from tooth wall and is due to the shrinkage that happen in the filling material after polymerization which leads to gap between the filling and the tooth structure [4].

Since 1960s composite materials have undergo a lot of research and development leads to the development of Nano–filled composites, Nano hybrid composite, flowable composite and bulkfillcomposite.

Nevertheless, despite the continuous evolution, problems such as polymerization shrinkage and marginal microleakage still occur. According to hooks law, stress at tooth restoration interface is determined by volumetric shrinkage and elastic modulus of the material.

Today, the use of composite in extensive posterior cavities is still associate with some clinical challenges because seal may be difficult to obtain in proximal cavities with cervical margins that extend to or below the CEJ.

The use of bulkfill have many advantages such as reducing working time and polymerization shrinkage, better adaptability to the cavity wall [5]

Material and method

20 human permanent maxillary first premolars extracted for orthodontic purposes were selected9 with no cracks, decay and fracture), cleaned and stored in normal saline. The teeth were divided into 2 groups 10 teeth of each, a standardized ClII MO cavities were prepared with fissure bur no(245) , for each 5 cavities a new bur was used , the dimension of the preparation is 2 mm occlusal extension, 3mm buccolingual and the gingival seat was placed on the C.E.J. [6] (fig 1)

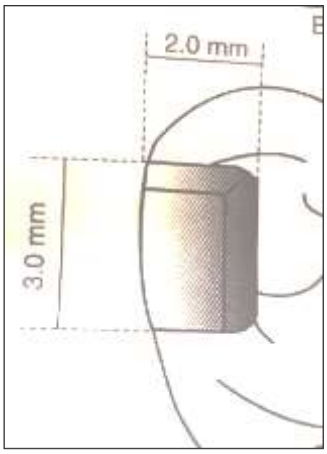

Fig. (1): Cavity Perp. Dimension

Each cavity was cleaned and dried; all the cavities of the teeth were etched with phosphoric acid 37% (fig 2) for 15 sec

Fig. (2): Phosphoric Acid

then rinsed with water for15 sec and dried then all the cavities treated with bond (single bond universal adhesive) (3M deutschland Gmbh-germany) (fig 3,4) then gently dried and cured. The teeth were then randomly divided into 2 groups of 10 each of each.

Fig. (3) Scotchbond

Fig. (4): Bonding Procedure

Group I was filled with bulkfill composite (3M ESPE filtek Bulk Fill posterior A3) (fig. 5) in sculptable technique: filling the whole cavity with bulkfill composite (fig. 6)

Fig. (5): Bulkfill composite

Group II filled with bulkflowable (fig. 7) and z350xt. (fig. 8) According to manufacturer instruction) (3M ESPE) in pizza technique (fig. 9): into which 2mm of the cavity filled with bulkflowable and the remaining of the cavity is filled with z350 xt composite. The groups named according to the surface being tested and as follow:

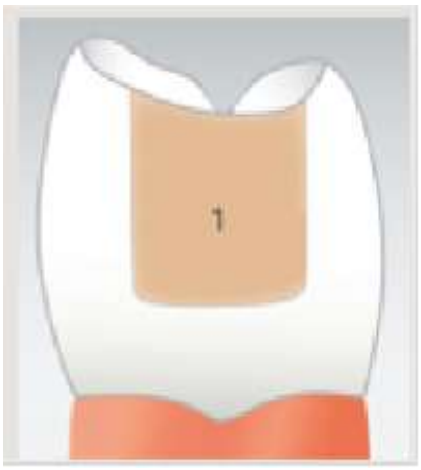

Fig. (6): Sculptable Technique

Fig. (7): Bulkflowable

Fig. (8): z350xt

Fig. (9): Pizza Technique

Groups:

- Group I: bulkfill composite from mesial box (cervical) named as group A.
- Group I: bulkfill composite from occlusal area named as group C
- Group II: bulkfillflowable from mesial box(cervical)named as group B
- Group II: z350xt from occlusal area named as group D

The specimen were stored in 100% humidity at 37c for 7 days and then submitted to Thermocycling machine (fig. 10) with 5c water for 30 sec then with 55c water for 30 sec and continue for 500 cycle .[7]

Fig. (10): Thermocycling machine

Upon completing the thermocycling, the teeth were covered with two layers of nail polish (white) except the 1mm below and above the tooth and the restoration from mesial and occlusal surface to prevent the dye from penetration to the unwanted area [8]. Then all the groups were immersed in methylene blue solution (1:10) for 30 min at 25º C [9]. Then the teeth were sectioned longitudinally from mesial to distal surface exposing the occlusal and cervical tooth- filling margin by using a specialized cutting sew under running water (fig. 11) and the samples (fig. 12) microscopically studied ,all the data were obtained with Mm. Sample viewed under 40% magnification (fig. 13) and under 100% magnification (fig. 14).

Fig. (11): Sewing machine

Fig. (12): Sample after cutting

Result

The means and standard deviations of microleakage of all experimental groups are shown in table (1).

Table (1): Descriptive statistic: Means, Standard Deviation, Minimum and Maximum values for each group.

Groups	Descriptive Statistics					
	N	Median	Mean	S.D.	Min.	Max.
A	10	565	578	131.470	350	850
B	10	1750	1615	617.364	850	2500
C	10	225	170	156.702	0	400
D	10	1050	1150	235.702	900	1500

From table (1), we see that the highest mean microleakage denoted at group (B) compared with other groups. And group (C) has the lowest mean microleakage as compared with other groups.

Table (2): Groups difference using independent sample t- test

Groups	Descriptive Statistics		Comparison	
	Mean	S.D.	t-test	p-value
A	578	131.470	-5.195	0.000
B	1615	617.364		
C	170	156.702	-10.949	0.000
D	1150	235.702		
A	578	131.470	6.308	0.000
C	170	156.702		
B	1615	617.364	2.225	0.039
D	1150	235.702		

From table (2), as there was a big variation between the minimum and maximum values, the data were managed as non-parametric data that means the median will be used instead of mean.

Table (3): Groups difference using man-whitney U test

Groups	Descriptive Statistics	Comparison	
	Median	Mann-Whitney U test	p-value
A	565	0.5	0.000
B	1750		
C	225	0	0.000
D	1050		
A	565	1.5	0.000
C	225		
B	1750	29	0.108
D	1050		

The highest median value of microleakage was recorded in group B followed by group D then group A and the least microleakage was in group C.

Comparing the microleakage between each two groups using Mann-Whitney U test revealed a high significant difference except between groups B and D where there was no significant difference (Table 3).

Discussion

In the current study, in order to analyze the extend of micrleakage in the specimen, the specimen where observed under high power microscope field (400x). The extents of dye penetration were measured using the standered scale located in the microscope. The microleakage of different type of composite were examined at the enamel and dentine after artificial aging

The descriptive statistics of the microleakage in clII cavities using two different materials namely bulkfill composite and flowable composite z350xt composite showed big variations between the minimum and maximum values. Therefore the data were managed as a non parametric data, that means the median were used instead of the mean.

Comparing the microleakage between each two groups using mann-whitney u test revealed a highly significant difference between group A & B were buklfill composite showed less microleakage at gingival part margins than bulk flowable. Also the statistical analysis showed a highly significant difference between group C + D, where bulkfill composite showed less microleakage at occlusal than flowable and z350xt groups

The new bulkfill flowable composite have been used in cl II restorations having the ability to guarantee an intimate contact with cavity surface, since it has minimal internal polymerization stresses because of longer pre gel phase due to the use of polymerization modulator which interact with camphor Quinone to reduce the contraction modulus and increase the number of linear bond [18,19].

The ability of adhesion of resins to infiltrate enamel and dentine is related to the surface wettability and the amount of surface free energy of dental substrate, which is directly proportional to the level of mineralization and indirectly proportional to the percentage of organic tissue content [12].

Studies have shown increased marginal leakage when the cervical margin is located below the cement-enamel junction. It is well known that adhesion strength and quality of marginal sealing have different predictability on enamel versus dentine [13, 14, and 15].

The statistical analysis also revealed non-significant differences between group B & D in which there was non-significant difference in marginal microleakage in the cervical margin where flowable composite resins are used and the marginal microleakage at occlusal margins were nano-hybrid z350xt are used.

Flowable resin composite with inorganic filler (44-55% by volume) and higher amount resinous content are low viscosity material causing intimate contact with the dentine cavity margins. Although the polymerization contraction of these materials are more, but with minimal stress at the teeth / restoration interface bonding [16, 17]. On enamel margins of group D, the nano-hybrid composite resin z350xt that was tested in the current study showed a non-significant difference from flowable composite resin used in group B, confirming that the quality of adhesion on enamel is able to overcome curing shrinkage regardless of the volumetric shrinkage of the resinous material used.

In contrast, the dentinal margins were flowable resins are used (group b), flowable composite showed superior behavior on dentine substrate where adhesion processes are less predictable and more difficult to achieve [20]. This can be explained by their lower stress on teeth /

adhesion interface due to low elastic modulus compared with the higher elastic modulus of other types of composite [21]

In addition, better wettability of flowable composite which make them to be readily inserted into small cavities and are expected to adapt better to the internal cavity wall [22]. The data concluded that bulkfill composite resin, showed less marginal micrleakage on both enamel and dentine as compared with bulk flowable and nano composite resin. Also both materials showed less microleakage when applied on enamel margins.

Fig. (13): Sample under 40x magnification

Fig. (14): Sample under 100x magnification

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