Assessment of microleakage of glass ionomer cement reinforced by different amount of Hydroxyapatite[+]

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ABSTRUCT:

This study was done to assist microleakage of glass ionomer cement reinforced by different amount of Hydroxyapatite. In this study a Hydroxyapatite materials were added to glass ionomer cement at different ratios;10%, 15%, 20%, 25% and 30% (by weight) and the mixed materials was used as filling for class V cavities in extracted premolars bucally and lingually and microleakage was detected by dye penetration methods.The results showed that glass ionomer cement reinforced by different amount of Hydroxyapatite has less microleakge at tooth / restoration interfaces than conventional glass ionomer cement. The addition of hydroxyapatite to conventional glass ionomer cement used as filling for class V cavity preparation causes reduction in microleakage at tooth / restoration interfaces

المستخلص:

في هذه الدراسة قد تم أضافة مادة فوسفات الكالسيوم المائية الى حشوة الكلاس أينومير بنسب مختلفة وهي ١٠% ،١٥%،٢٠%،٣٠% (النسب تم احتسابها بالوزن) ومن ثم تم مزج الحشوات لملأ الحفر السنية المحضرة من الصنف الخامس من أنواع الحفر السنية على أسنان مقلوعة من نوع الضواحك وعلى كلا السطحين الخدي واللساني من سطوح هذه الاسنان، وتم فحص التسرب المجهري لهذه الحشوات بطريقة ألاختراق الصبغي، أظهرت النتائج أن حشوات الكلاس أينومير المقوات بواسطة أضافة مادة فوسفات الكالسيوم المائية أظهرت أقل تسرب مجهري بين سطح السن وسطح الحشوات الجديدة مقارنة بالحشوات التقليدية من مادة الكلاس أينومير، وعليه فان اضافة مادة فوسفات الكالسيوم المائية الىحشوة الكلاس أينومير يقلل من التسرب المجهري لهذة الحشوات.

INTRODUCTION:

The conventional glass inomer cements were first introduced by Wilson and kent in 1971, and developed for clinical usage by Mclean and Wilson in 1977. Since then their applications in operative dentistry have steadily increased. [1,2] The glass ionomer cement has been used as filling, liner, luting material and as core material, in attempt to take advantage of two highly desirable properties, chemical bond to the tooth structure and fluoride realize.[3] Although fluoride release from glass ionomer decrease with time, sustained release has been demonstrated with corresponding uptake into adjacent tooth structure this is thought to aid in anticariogenic activity.[3] The main advantages of glass ionomer cement include, the ability of material to bond physicochemically to tooth structure by ionic interaction with the calcium ions in enamel and dentine, biocompatibility, fluoride releasing and it has coefficient of thermal expansion is close to that of dental hard tissues and has been cited as a significant reason for the good margin adaptation glass ionomer cement restorations.

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Even though the shear bond strength of glass ionomer cement does not approach that of the latest dentine bonding agent, glass ionomer cement restorations placed in cervical cavities are very durable nevertheless, microleakage still occurs at the margins.[4,5]The seepage of the oral fluid, Bacteria, Toxic materials and soluble ions into the space between the restoration and cavity walls causes many problems such as post operative sensitivity, irritation of the pulp especially in deep cavities, color changes of the tooth structure or secondary caries around the restoration.[6] Thus this study was conducted to investigate and assess the sealing properties of glass ionomer cement reinforced by different ratios of hydroxyapatite used in class V cavity preparation

MATERIALS AND METHODS:

Sample grouping:

sixty freshly extracted sound human maxillary first premolar teeth were collected, scalled and polished, a standardized a standardized class V cavity preparations were prepared on buccal and lingual surfaces of these teeth with 3 mm width (mesio-distally), 2mm height (occluso-gingivally) and 2mm depth (bucco - lingually) after proper cleaning and dryness the teeth were randomly divided into six groups and restored by the experimental and control materials, each group has 20 cavities as shown in Table(1):

Table(1):The control and experimental groups of the glass ionomer cement and glass ionomer cement reinforced by different amounts of Hydroxyapatite

Group I (controle)	glass ionomer cement
Group II (Experimental)	glass ionomer cement reinforced by 10% of Hydroxyapatite
*GroupIII (Experimental)	glass ionomer cement reinforced by 15% of Hydroxyapatite
Group IV (Experimental)	glass ionomer cement reinforced by 20% of Hydroxyapatite
Group V (Experimental)	glass ionomer cement reinforced by 25% of Hydroxyapatite
Group VI (Experimental)	glass ionomer cement reinforced by 30% of Hydroxyapatite

The restored teeth were stored in a incubator at 37 C', for one month , the roots and apices of teeth were coated with two layers of nail varnish except the restoration area and 1 mm around it the teeth thermo cycled in the 0.5% basic fuchsia dye at temperatures were 5 C^o cold water bath and 55C^o hot water bath for 300 cycles, the immersion time was 30 seconds in each bath , the teeth were sectioned longitudinally (bucco-lingually) through the restoration by accustom sectioning device , the dye penetration were detected by stereomicroscope at both gingival and occlusal tooth / restoration interfaces . The scores were used to express the amount of dye penetration which were the same score's criterias used by BenAmar in 1987 (table 2).

Table 2:The scoring criteria of amount of linear dye penetration of 0.5 % Basic fuchsin dye.

Score	Score's criteria
0	**No dye penetration**
1	**Penetration of dye up to 0.5 mm**
2	**Penetration of dye up to 1 mm**
3	**Penetration of dye up to 1.5 mm**
4	**Penetration of dye up to 2 mm**

RESULTS:

The result showed (Table 3) and (figure 1) that the group I has the highest values of microleakage while the group V has the lowest values of microleakage .

Table 3:Means and standard deviations of microleakage of all groups.

Groups	Mean (MP)	± SD
I	3.65	0.67
II	1.1	0.641
III	0.8	0.768
IV	0.65	0.587
V	0.5	0.513
VI	1.15	0.489

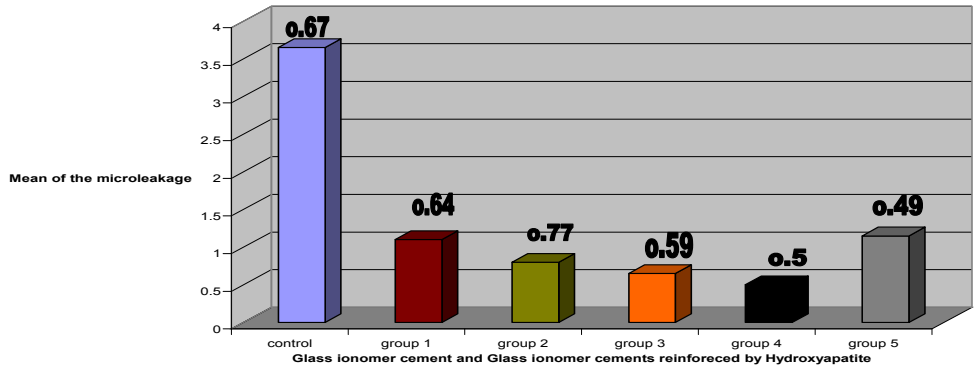

Figure 1 : Microleakage of Glass ionomer cement and Glass ionomer cements reinforced by different percentages of Hydroxyapatite (10%,15%,20%,25% and 30%).

One way ANOVA test (table 4) showed that there was statistically significant difference among all groups at the P value less than 0.01.

LSD statistical test to compare between each paired groups (Table5) showed that there was statistical significant difference between group I as compared with other groups, also the result showed there was statistical significant difference between group II with group IV and group V also there was statistical significant difference between group IV with group VI and when compare the group V with group VI. except when compare the group II with group III and group VI, also when compare the group III with group IV , group V and group VI the result showed that there was no statistical significant difference at level P less than 0.05 .

Table (4):ANOVA test of the all tested groups:

Source	Sum of square	df	Mean square	F	P(valu
Between groups	137.942	5	27.588	72.052	P<0.01
Within groups	43.650	114	0.383		
Total	181.592	119			

d.f.=degree of freedom

P-value=probability

F=freedom

Table(5):LSD statistical test to compare between the groups

Statistic		
Comparison (I)group X (J)group	Mean difference (I-J)	Sig.
I X II	2.55*	0.000
I X III	2.85*	0.000
I X IV	3.00*	0.000
I x V	3.15*	0.000
I X VI	2.50*	0.000
IIX III	3.00	0.128
IIX IV	0.54*	0.023
II X V	0.60*	0.003
II X VI	-0.05	0.799
III x IV	0.15	0.445
III X V	0.30	0.128
III X VI	-0.35	0.076
IV X V	0.15	0.445
IV X VI	-0.50*	0.012
V x VI	-0.65*	0.001

* The mean difference is significant at the 0.05 level.

DISCUSSION:

Comparable preconditions of this in vitro study were created by means of standardized preparation form and a random distribution of the teeth samples to the six groups that were filled with conventional glass ionomer cement and conventional glass ionomer cement reinforced with different ratio of hydroxyapatite. In the present investigation, microleakage was determined with dye penetration at the gingival and occtusal tooth / restoration interfaces this method is accepted method for evaluation of dental materials leakage.[7] This method was applied with thermocycling, some authors could not find a correlation between dye penetration and thermocycling stress.[8,9]In contrast to this, other investigaters did show a significant difference before and after

thermocycling.[10] The results of this study showed that non of all groups preventing microleakage, but the addition of hydroxyapatite to the conventional glass ionomer cement causes in reduction the microleakage significantly this may be due to change in the mechanism of adhesion to tooth structure. In conventional glass ionomer the adhesion is initiated by the polyalkenoic acid when freshly mixed material contacts the tooth surface. Phosphate ions are displaced from apatite by carboxyl group, each phosphate ion taking a calcium ion with it to retain electrical neutrality. Therefore, it appears that chemical bonding is achieved by a calcium phosphate-polyalkenoate crystalline structure acting as an interface between dentine and a set material.[11,12] but with the glass ionomer cement reinforced by hydroxyapattite the chemical bonding is achieved by a calcium phosphate-polyalkenoate crystalline structure acting within the set material and between dentine and a set material. The better bonding mechanism may be the cause of better sealing ability. Also the result showed that the group with 25% hydroxyapatite gave lest microleakage this may due to their setting reaction gives more chemical bonds to the tooth structure like a calcium phosphate-polyalkenoate crystalline structure.[11,12]

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