# SINIF V KAVİTELERDE FARKLI RESTORASYON MATERYALLERİNİN MİKROSIZINTILARININ KARŞILAŞTIRILMALI OLARAK İN VİTRO DEĞERLENDİRİLMESİ

## COMPARATIVELY IN VITRO ASSESSMENT OF MICROLEAKAGE OF DIFFERENT RESTORATIVE MATERIALS IN CLASS V CAVITIES

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**Özet**

Bu çalışmanın amacı sınıf V kavitelerde kompozit, akıcı kıvamdaki kompozit, cam ionomer siman ve kompomer restorasyon materyallerinin mikrosızıntılarının in vitro şartlarda değerlendirmektir.

Bu çalışmada 60 adet premolar dişte Sınıf V kaviteler hazırlandı.. Grup 1: yüksek viskoziteli cam ionomer GC uygulandı ve daha sonra tüm yüzeyine koruyucu rezin uygulandı.Grup 2:Clearfil S$^3$ Bond ve Clearfil Majesty Flow**.** Group 3: Clearfil S$^3$ Bond ve Clearfil Esthetic kompozit uygulandı**.** Group 4*:* kompomer uygulaması yapıldı. LED ışık kaynağı kullanılarak polimerize edildi. Bütün örnekler 24 saat distile su içerisinde bekletildi. 5 ve 55°C termal siklus işlemi 10000 kez uygulandı. 24 saat %0,5'lik metilen mavisi solüsyonunda bekletildi. Dişler bukko-lingual yönde kesildi. Mikrosızıntı skorları 0-4 arasında skorlanarak değerlendirildiElde edilen veriler istatistiksel olarak Kruskal Wallis ve Mann Whithney U testleri kullanılarak analiz edildi.

Oklüzal ve gingival mikrozınıt değerlerine göre gruplar arasında istatistiksel olarak anlamlılık bulundu($p<0.05$). Fuji IX oklüzal ve gingivalda mikrosızıntı diğer gruplardan oldukça düşük bulundu. Freedoom ise en fazla mikrosızıntı gözlendi ($p<0.05$).Diğer gruplar (Majesty estetik-Majesty flow) arasında ise istatistiksel olarak fark bulunamadı.

Araştırmanın sonucunda, test ettiğimiz restoratif materyallerin hiçbirisi mikrosızıntıyı tam olarak engeleyememiştir. Bununla beraber yüksek vizikoziteli cam iyonomer siman ve kompozit, akıcı kompozit ve kompomere gore daha iyi marjinal kapanma sağlamıştır.

**Anahtar Kelimeler:** Mikrosızıntı, Termal Siklus, Fuji IX Extra, Akıcı Kompozit, Kompomer.

**Abstract**

The aim of this study was to evaluate in vitro microleakage of restoration materials; high viscosity glass ionomer cement, flowable composite, composite and compomer in class V cavities.

The buccal surfaces of 60 premolars were prepared with Class V cavities. Group 1: Cavities were restored with high viscosity glass ionomer GC, preventive resin was applied. Group 2: Clearfil S$^3$ Bond and Clearfil Majesty Flow**.** Group 3: Clearfil S$^3$ Bond and Clearfil Esthetic composite were applied**.** Group 4*:* Compomer was applied. Then polymerized with LED. 24 hours of storage at 37 °C, thermocycled for 10000 cycles, immersed in 0.5 % methylene blue, sectioned buccolingually. Microleakage scores were assessed on a scale of 0 to 4, statistically analyzed with Kruskal Wallis and Mann Whitney U tests.

For microleakage scores, statistically there was significance among groups ($p<0.05$). For Fuji IX, occlusal and gingival microleakage scores were lower. The highest microleakage scores were found in compomer group, of other groups were similar.

None of the restorative materials tested in this study completely eliminated microleakage. However, both the high viscosity glass ionomer and composite provided better margin sealing than both of the flowable composite and compomer.

**Key Words:** Microleakage, Thermocycle, High Viscosity Glass Ionomer, Flowable Composite, Compomer.

## INTRODUCTION

Usually composite, glass ionomer and compomer are applied to restore defects occured on cervical region of teeth like caries, erosion, abfraction and abrasion. Additionally, these cases are assessed to be difficult because of being just adjacent to gingival tissues and being subjected to abfraction forces. So minimizing microleakage in restoration of cervical lesions has been an important aim of recent studies (1).

In recent years with development in adhesive materials, conservative cavity preparation techniques that provide less removal of tooth structure were advanced (2, 3).Especially against amalgam restorations

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without reinforcement of enamel, and adhesive dental materials like composites, compomers and glass ionomer cements as well as their high adhesive forces also provide an important advantage in preventing microleakage that may develop in tooth-restoration margins which is going to cause seconder caries (2, 4, 5).

By development of dental adhesives for facilitation in clinicians' work and satisfying esthetical expactations of patients, new materials and technics are advanced. Flowable composites which were advanced for better adaptation of material to cavity in 1990s have smaller particle sizes and proportions than hybrid composites which have low viscosity and high flowability (6, 7). Flowable composites are used in restorations of class V cavities, in narrrow areas like pits and fissures and also because of their low elastic modulus are used under hybrid and packable composites as stress breaking base material (7, 8).

Traditional glass ionomer cements have been used since 1970s in dentistry and beginning from 1980 by means of their positive features as thermal expansion coefficient, tooth like minimal contraction during polymerization (hardening), success in adhesion to enamel and dentine and biocompatibility they have great progression in indications and application methods (9, 10, 11). And also they have some advantages like lower thermal expansion coefficient, easy application, decreasing marginal microleakage and some missions as flour releasing and flour reservoir (12). Additionally, glass ionomer cements are not as much esthetic as composites and have some disadvantages like weaker physical features, lesser fracture and abrasion strength, sensibility to dryness and humidity (13).

These materials have advantages like chemical adhesion to enamel and dentine, flour releasing, tooth relative thermal expansion coefficient and lesser contraction during polymerization (14, 15, 16). But traditional glass ionomer cements have disadvantages like sensibility to humidity and dryness and bad esthetical features (17, 18). These disadvantages weaken physical features of materials and restrict their usage in regions that are exposed to chewing forces (17, 18). So, for providing total curing reaction in glass ionomer cements it is provided to prevent humidity and salivary exposure in earlier stages (19, 20). In many studies it was shown that exposure to water in early stages effects mechanical and physical properties of chemically cured traditional glass ionomer cements negatively (21, 22, 23).

As a result of early exposure to water; lower clinical performance, lower translucency, lower shearing strength, decreasing in strength of material and increasing in solubility was reported (21, 24). Because of this for preventing problems that can occur after exposure to water, application of varnish, cacao oil or light cured protective resin was recommended (18, 25). It was reported that covering surface of material with a water resistant protective layer in first 24 hours prevents water resorption from outer surrounding and increasing shearing strength by causing more cross connection occurance (26, 27). It is thought that covering newly curing restorative material with light cured protective resin provides more protection than evaporating varnishes (28, 29). Nano fillers were added to structure of protective resin to provide long lasting of material on restoration surface and preventing abrasion of resin (30). And also, it is said that nano filler including and light cured this resin increases abrasion resistance of glass ionomer cements (31). High abrasion resistance of restorative materials is nearly related with high hardness values against chewing forces (32).

The aim of this study was to assess in vitro microleakage scores of composite, flowable composite, glass ionomer cement and compomer restorative materials in class V cavities.

## MATERIALS AND METHODS

Sixty human premolars extracted due to orthodontic and periodontal reasons were used in this study. They were free from caries and/or restorations and had no developmental defects. Surface debridement of all the teeth was done with hand-scaling instruments and the teeth were stored in normal saline at room temperature till further use. Teeth were randomly assigned into 4 groups of 15 teeth each.

A standardized Class V cavity, 3.0 mm wide (mesial-distal), 2.0 mm high (occlusal-gingival), and 1.5 mm deep, was prepared on the buccal surfaces of each tooth with the occlusal margin located 1.0 mm on enamel and the gingival margin located 1.0 mm on dentin/

cementum. This resulted in the creation of a total of 60 class V cavities (buccal) on the 60 teeth. The preparations were made using #12 diamond round burs (Drendel Zweiling, Diamont Gmblt Georzalee, Germany) in a water-cooled, high-speed handpiece. Each bur was used for four preparations and then replaced. The teeth were randomly assigned to four groups of 15 preparations based on the configuration of the enamel cavosurface margin as follows:

**Group 1:** High viscosity glass ionomer cement (Fuji IX Extra capsule, GC, Tokyo, Japan) was applied. Glass ionomer cement was applied according to recommendations of manifacturers'. Cement including capsule was shaked before activation for gaining viscosity to the powder. The process at the bottom edge of capsule was compressed towards capsule body for activation. Capsule was activated by pressing once on the capsule applier (GC Capsule Applier, GC, Tokyo, Japan). Activated capsule was mixed in automatic mixer (Amalgamix II, Gnatus, Sao Paulo, Brasil) for 10 s. Then after applying glass ionomer cement to the cavity, the whole surface was coated with protective resin (G-Coat Plus, GC) according to manifacturers' recommendations and was polymerized with LED (Light Emitting Diode-Elipar Freelight, 3M ESPE, Germany) for 20 s.

**Group 2:** Flowable composite Clearfil Majesty Flow-Kuraray Dental, Japan) + Clearfil $S^3$ Bond. Clearfil $S^3$ Bond (Kuraray Dental, Germany) was applied to cavity surfaces and waited for 20 s. Then cavity was dried with a high air pressure for 5 s and was polymerized with LED (Light Emitting Diode-Elipar Freelight, 3M ESPE, Germany) for 10 s. Finally flowable composite was applied to the cavity and then polymerized with LED (Light Emitting Diode-Elipar Freelight, 3M ESPE, Germany) for 20 s.

**Group 3:** Clearfil $S^3$ Bond (Kuraray Dental, Germany + Clearfil Majesty Esthetic (Kuraray Dental, Japan). Clearfil $S^3$ Bond (Kuraray Dental, Germany) was applied to cavity and after 20 s cavity was dried for 5 s and polymerized for 10 s. Finally composite (Clearfil Majesty Esthetic (Kuraray Dental, Japan) was applied and polymerized with LED Light Emitting Diode-Elipar Freelight, 3M ESPE, Germany) for 20 s.

**Group 4:** Compomer (Freedom compomer SDI LTD.5-9 Brunsdon Street, Bayswater. Australia). First 37% phosphoric acid was applied for 20 s. After washing with water for 15 s the cavity was dried with a gentle air pressure and adhesive (stae bonding- SDI LTD. 5-9 Brunsdon Street, Bayswater. Australia) was applied during 20 s, then polymerized with LED (Light Emitting Diode-Elipar Freelight, 3M ESPE, Germany) for 20 s. Finally compomer was applied to cavity and polymerized for 20 s with LED (Light Emitting Diode-Elipar Freelight, 3M ESPE, Germany).

After completing all of the restorations, finishing and polishing procedures of restorations were done with thin roughed diamond burs and aluminium oxide covered discs (Sof-Lex, 3M ESPE, St. Paul, MN, USA) under water cooled system. After finishing and polishing procedures teeth were waited at 37 $^{o}$C of 100% humidity for 24 h. After 24 hours of storage at 37 $^{o}$C, the samples were thermocycled for 10000 cycles at 5-55 $^{o}$C ±2 of 30 s dwelling time (NOVA, Konya, Turkey). Then nail varnish was applied twice on all surfaces of each tooth except 1 mm surrounding of the restorations before storage at 37 $^{o}$C for 24 h in 0.5% methylene blue. For assessment of microleakage teeth were sectioned bucco-lingually and vertically into two pieces with a diamond separator under water cooled system using Isomet (Isomet, Buehler Ltd, Lake Bluff, IL, USA) device. Scores of dye infiltration in cavity margins were assessed by two experienced observer, who did not know what the used materials were, under stereomicroscope separately (Olympus Co., Tokyo, Japan) at 30X magnification. And different scores of samples were again assessed by the same two observers together. Then just one score about each sample was recorded (Table 1). Obtained sections were assessed as **Lucena-Martin et al.** evaluated in their study under stereomicroscope for microleakage score (picture1-4). And these criteria's were as below;

***For occlusal region;***

0-No microleakage
1-Microleakage includes ½ or less than ½ of cavity depth.
2-Microleakage includes more than ½ depth of cavity
3-Microleakage includes ½ of floor of the cavity
4-Microleakage expanded cavity floor on pulpal wall.

***For gingival region;***

0-No microleakage
1-Microleakage includes only ½ of cavity floor.
2-Microleakage includes the whole cavity floor
3-Microleakage includes ½ of axial wall
4-Microleakage includes more than ½ of axial wall

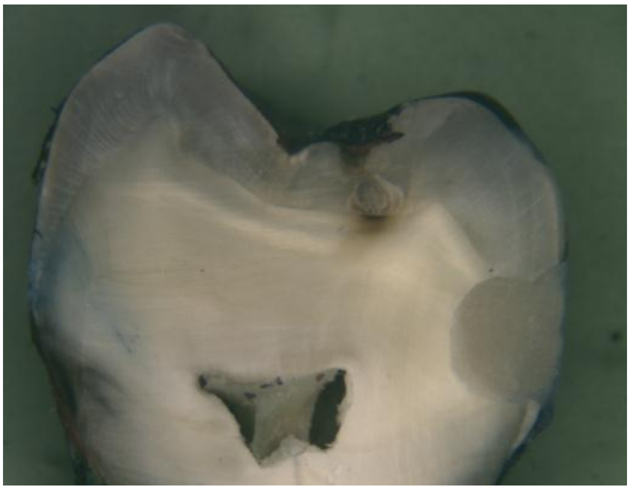

**Figure 1:**Fuji IX GP (occlusal=0, gingival=1)

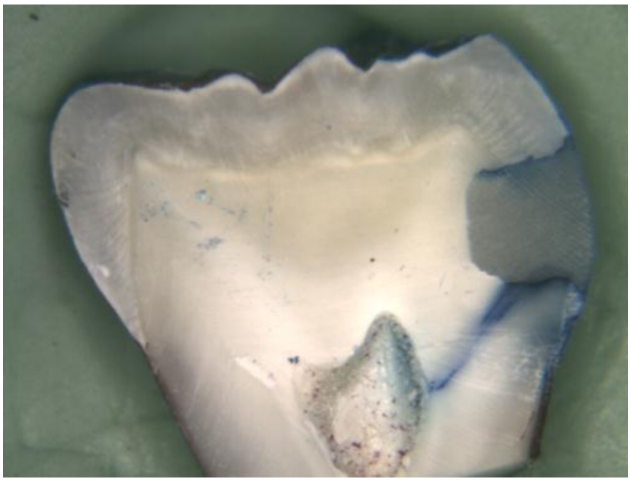

**Figure 2:**Clearfil Majesty Flow (occlusal=2,gingival=4)

Scores obtained from microleakage test were statistically assessed with Kruskall-Wallis and Mann Whitney U tests by using SPSS software (SPSS 11.5, Chicago, Illinois, USA). One sample was chosen from each group randomly. Teeth were Au coated in ion coating unit (Polaron SC 500 Sputter Coater, England). Then dental hard tissue-restorative material interfaces were investigated and photographed under Scanning Electron Microscope (Scanning Electron Microscope, SEM) (JSM-5600 JEOL SEM, Jeol Co., Tokyo, Japan) (Picture 5-8)

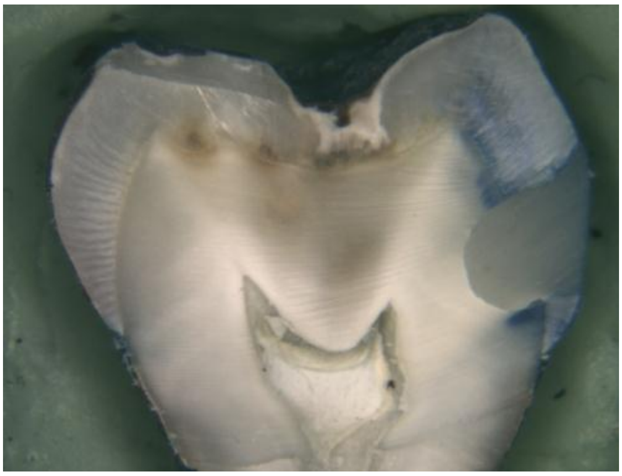

**Figure 3:** Clearfil Majesty Esthetic (occlusal=1, gingival=2)

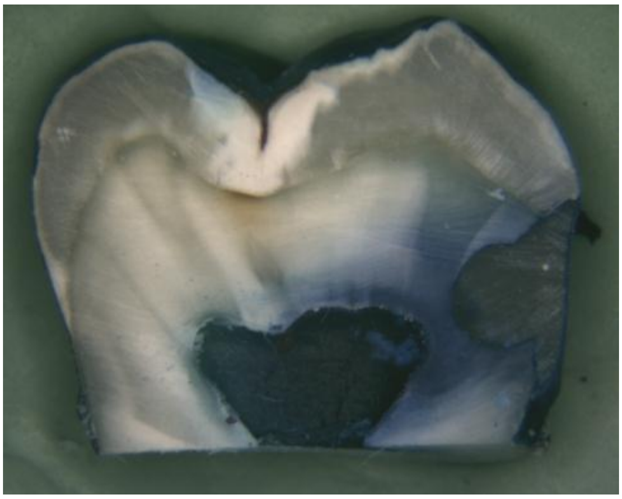

**Figure 4:** Freedom compomer (occlusal=1, gingival=4)

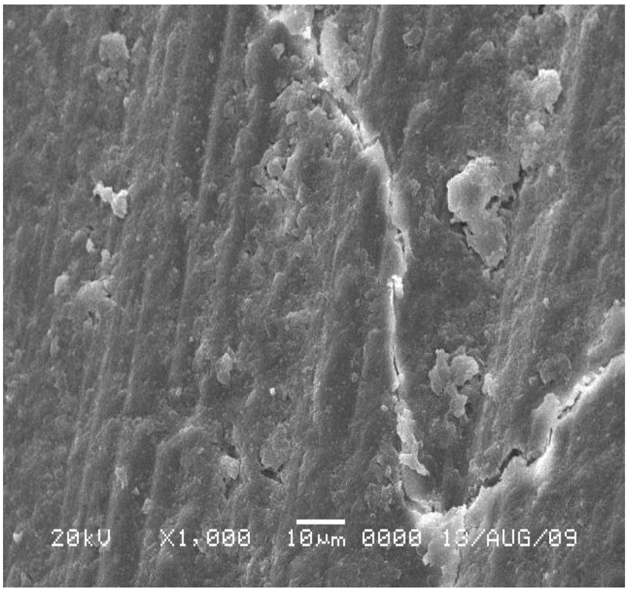


**Figure 5:** Fuji IX GP (SEM image

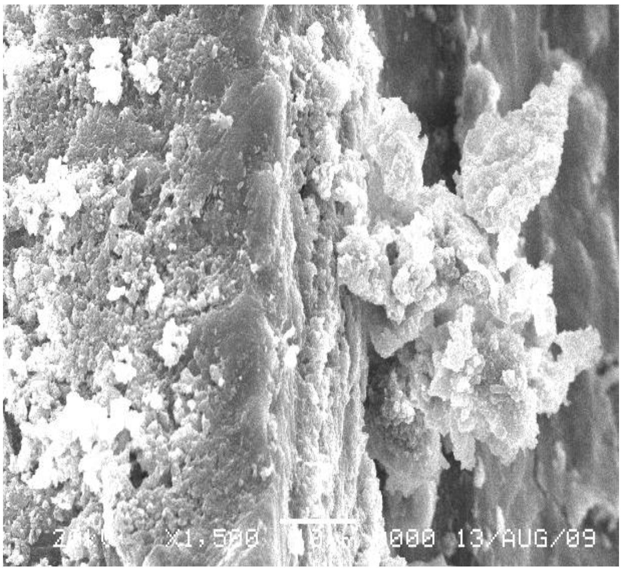

**Figure 6:** Clearfil Majesty Flow (SEM image)

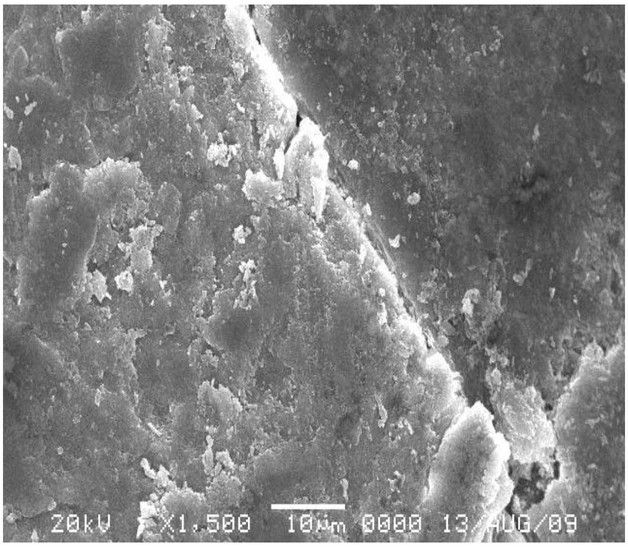


**Figure 7:** Clearfil Majesty Esthetic (SEM image)

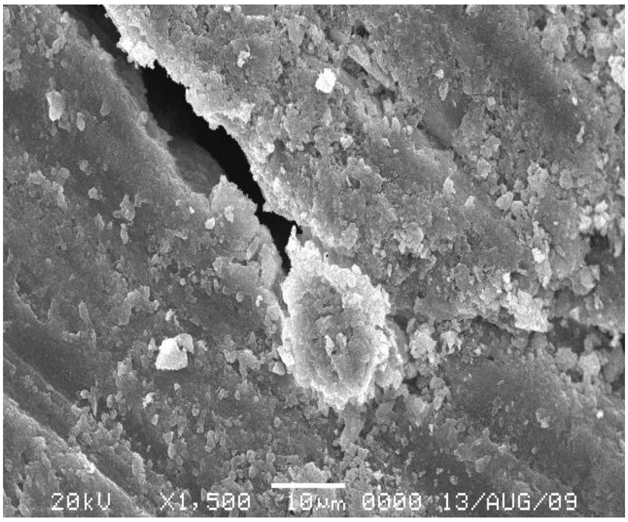


**Figure 8:** Freedom compomer (SEM image)

## RESULTS:

Distribution of the degree of microleakage associated with sections from individual teeth in the four test groups ranged from 0-4. Table 1 lists frequency of microleakage scores at both occlusal and gingival margins. The Mann-Whitney U test for comparison of the mean rank of microleakage in enamel and dentin margins of each group showed a significant difference (P<5%) (Table 1)

| | | Microleakage scores | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 |
| Group 1 | Gingival | 8 | 4 | 2 | 1 | - |
| | Occlusal | 7 | 8 | - | - | - |
| Group 2 | Gingival | 8 | 5 | 2 | - | - |
| | Occlusal | 7 | 5 | 3 | - | - |
| Group 3 | Gingival | 8 | 3 | 4 | - | - |
| | Occlusal | 5 | 9 | 1 | - | - |
| Group 4 | Gingival | 1 | - | - | - | 14 |
| | Occlusal | 2 | 2 | 1 | 4 | 6 |

**Table 1:** Gingival and occlusal microleakage scores of four groups

According to Kruskal Wallis variance analysis, statistically there was significance among groups in occlusal and gingival (p<0.05). Both in occlusal and gingival statistically there was significant difference between Group 1 and the other groups(p<0.05). In occlusal, the difference among the other three groups was not significant statistically. In gingival,statistically there was no difference among group 1,group 2 and group 3(p>0.05). But statistically there was difference between groups 1 and 4 (p<0.05). And also there was difference between groups 3 and 4 statistically (p<0.05). Statistically there was no difference between groups 2 and 4 (p>0.05).

## DISCUSSION

By development of dental adhesives for facilitation in clinicians' work and satisfying esthetical expactations of patients new materials and technics are advanced. Flowable composites which were advanced for better adaptation of material to cavity in 1990s have smaller particle sizes and proportions than hybrid composites which have low viscosity and high flowability (6,7). Flowable composites are used in restorations of class V cavities, in narrrow areas like pits and fissures and also because of their low elastic modulus are used under hybrid and packable composites as stress breaking base material (7,8) .

Traditional glass ionomer cements have been used since 1970s in dentistry and beginning from 1980 by means of their positive features as thermal expansion coefficient, tooth like minimal contraction during polymerization (hardening),success in adhesion to enamel and dentine and biocompatibility they have great progression in indications and application methods (9,10,11). And also they have some advantages like lower thermal expansion coefficient, easy application, decreasing marginal microleakage and some missions as fluor releasing and fluor reservoir (12).

Additionally,glass ionomer cements are not as much esthetic as composites and have some disadvantages like weaker physical features ,lesser fracture and abrasion strength, sensibility to dryness and humidity (13). Microleakage can result in saliva, salivary components and bacteria penetrating the tooth-restoration space and into dentinal tubules, where causing staining and breakdown at restoration margins, postoperative sensitivity, pulpal reactions, and secondary decay may occur and bacterial toxins will irritate the pulp (33). None of the systems tested in this study completely eliminated microleakage. However, both the flowable composite and compomer provided stronger dentine bond strengths and better margin sealing than the conventional glass ionomer cement (34). The results of the present study demonstrate better sealing ability in enamel than in dentin or the cementum margin, this is in accordance with previous study. It was found that no material completely eliminate microleakage at enamel margin. Group I showed better results when comparing with group II and group III.

In a study of Brackett et al (1998), marginal microleakage of a compomer (dyract) and two glass ionomer restorations (Fuji II LC, Vitremer) were evaluated. There was no significant difference between marginal microleakage of these three restorations (35). In this present study, microleakage of occlusal and gingival walls of high viscosity glass ionomer cement (Fuji IX Extra) were significantly less than compomer restorations (P=0.000).

## CONCLUSION

These data indicated that high viscosity glass ionomer cement (Fuji IX Extra capsule) and composite had lesser microleakage in occlusal and gingival walls of class V cavities when compared with flowable composite and compomer. In contrast, the light-cured glass ionomer had lesser microleakage in the gingival and gingival plus axial walls when compared with compoglass.

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