PLAQUE FORMATION AND MARGINAL GINGIVITIS ADJACENT TO CLASS V CAVITIES RESTORED WITH COMPOSITE VERSUS GLASS IONOMER IN CHILDREN

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ABSTRACT

Abstract: The aim of this study was to investigate plaque retention and the condition of the gingiva adjacent to class V cavities restored with glass ionomer versus composite restoration and to compare the initiation of gingivitis around these restorations with that around enamel within nine month intervals.

Subjects and Methods: This study was conducted on thirty children (16 girls and 14 boys) aged (5-7) years; they were selected from the outpatient clinic of the Pediatric Dentistry and Dental Public Health Department, Faculty of Dentistry, Ain –Shams University.

The purpose of the study was clearly explained to the patients and they agreed by signing an "Informed Consent". The children were randomly assigned to either the Fuji IX or to resin composite 3M™ ESPE™ Filtek™ Bulk Fill Flowable.

Results: No statistically significant difference were seen in plaque and gingival index scores between the materials at the first three months but there was statistically significant increase in plaque and gingival index scores in Fuji IX group after three months till nine months intervals. At the enamel surface, as well as at Fuji IX and resin composite sampling sites; there was no statistically significant change in mean Log10 CFU of Streptococci counts and Actinomyces spp. counts.

KEYWORDS: Fuji IX, gingivitis, resin composite, Streptococci counts, Actinomyces spp.

INTRODUCTION

Restoration of primary teeth is an important part of restorative dentistry. [1] Class V restorations can be restored with any of the esthetic restorative materials present. [2]

From the variables which affect the decision and ultimate outcome of whatever restorative treatment is chosen are the esthetic concern by parents, the child's behavior, and moisture control. [1]

Composite resin, glass ionomer cements (GICs) and compomers have been indicated as the

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restorative materials of choice for Class V in primary teeth. [3]The presences of such restorative materials on tooth surfaces are perceived to be a contributing factor to Plaque-induced gingivitis. [4]

Plaque tends to adhere better to restorations than to enamel. This may result from the surface characteristics of restorative materials such as surface roughness and surface-free energy inherent in the restorative materials. [5]

It was found that the smoother surfaces of restorative materials correlate with less plaque accumulation. [6]The composition of dental plaque can be affected by the chemical properties of different restorative materials. [7]

It was found that the percentage of mutans streptococci in in vivo plaque was reported to be 13.7% on composite and 1.1% on glass ionomer cement. These differences might be caused by physical parameters or by the antibacterial effects of the dental materials. Glass-ionomer release ions with bacteriostatic properties in contrast to composite. [8]

The reported high colonization level of composite compared to glass ionomer suggest a causative relationship, thus it seems clinically relevant to study the levels of mutans streptococci and other caries-associated bacteria in initial plaque on sound tooth enamel and compare them with the flora on composites. [8]

Therefore this study was designed to investigate the amount and composition of plaque and the condition of the gingiva adjacent to class V cavity restored with glass ionomer versus composite restoration and to compare the initiation of gingivitis around these restoration with that around enamel within nine month intervals.

SUBJECTS AND METHODS:

This study was conducted on thirty children (16 girls and 14 boys) aged (6-8) years with one or two pairs of carious cervical lesions were included

in the study; they were selected from the outpatient clinic of the Pediatric Dentistry and Dental Public Health Department, Faculty of Dentistry, Ain – Shams University.

The faculty research ethics committee reviewed the research proposal, and had given a clearance to conduct the study.

Exclusion criteria:

1. Teeth with deep caries lesion.

2. Presence of soft tissue abscess or sinus tract around the teeth.

3. Teeth which are not restorable.

4. Patients with anterior teeth malocclusions.

5. Patients with oral habits.

6. Mentally challenged patients.

    The samples were divided into 2 groups:

Group 1: fifteen teeth to be restored with *GC Fuji IX GP* for class V cavity preparation in primary canine or first molar.

Group 2: fifteen teeth to be restored with resin composite 3M™ ESPE™ Filtek™ Bulk Fill flowable for class V cavity preparation in primary canine or first molar.

After caries removal and thoroughly cleaning of the cavities with water spray, the manufacturer's directions were closely adhered to regarding cavity treatment and placement of the restorative materials.

In all patients the operative field was isolated by means of cotton rolls and a suction device

The cavity for GC Fuji IX GP GC, dentin conditioner (20 seconds) was applied to the bonding surfaces using a cotton pellet or sponge and rinsed thoroughly with water. Excess water was blotted away with a cotton pellet. Final finishing under water spray was performed after approximately 3 minutes after start of mixing. Final coat of GC G-COAT Plus was applied and light cured for

20 seconds. The patients were instructed not to apply pressure for 1 hour.

To bond Filtek Bulk Fill flowable to tooth structure, 3M™ ESPE™ Scotchbond™ Universal adhesive system was used.

Oral hygiene instructions and motivation were given to the children and their parents. The subjects were recalled at regular intervals for follow-up, at:

- 1 month

- 3month

- 6 month and

- At 9 months.

Plaque index (PI) [9]and Gingival index (GI) [10] as described by Sillness and Loe, were used for monitoring the gingival health and plaque accumulation at 3 scoring sites for each patient:

- **(G)** Buccal surface of the tooth restored by GC Fuji IX GP .

- **(F)** Buccal surface of the tooth restored by Filtek™ Bulk Fill.

- **(C)** Non-restored Control molar tooth in the opposing arch

Steps of evaluation of the plaque deposits and gingival health:

I. The GI & PI for the assigned teeth were recorded before the placement of restorations, and in follow up visits at 1 month, three months, six months and nine months intervals.

Fig. (1) preoperative case of carious cervical lesions.

Fig. (2) postoperative case after filling with Bulk Fill composite

Fig. (3) preoperative case of carious cervical lesions

Fig. (4) postoperative case after filling with Fuji IX

A sterile periodontal probe* was used to collect the supragingival plaque available on the selected teeth, while recording the (PI) and the (GI).

II. The plaque samples were collected from each patient at the same three sites of indices recording; these sites were referred to as the *sampling sites:*

- **(G)** Buccal surface of the tooth restored by GC Fuji IX GP .

- **(F)** Buccal surface of the tooth restored by Filtek™ Bulk Fill.

- **(C)** Non-restored Control molar tooth in the opposing arch.

Plaque samples were collected before and 3 months after the filling placement. Immediately prior to collecting the plaque sample, an air syringe was used to lightly dry the site to be sampled, to reduce the risk of contamination with saliva (which might cause an inaccurate result). The collection was conducted by a sweeping action across the entire chosen tooth surface using a sterile periodontal probe. [11]

III. Each plaque specimen was then suspended in 4ml of reduced transport fluid medium (0.4% agar, 0.15% thioglycollate/ phosphate buffered saline**) [12] in sterile tubes placed on ice in an icebox and transferred to the laboratory of Medical Microbiology and Immunology Department, Faculty of Medicine, Ain Shams University, where all the samples were processed at the same day of sample collection.

The proximity to the microbiology laboratory permitted the culturing of the sample within 1 h after its collection. Thus the data obtained from these samples should exhibit the least of adverse effects the culturing delay might introduce.

IV. The samples were dispersed using a vortex mixer at maximal setting for 60 seconds. Under aspetic conditions using gloves by the operator, the samples were serially diluted with sterile normal saline. Using a sterile disposable calibrated loop, 0.1 ml of dilution 10-3, was spread onto the following selective media:

A. Mitis salivarius agar (MSA) supplemented with 0.2 U/ml bacitracin and potassium tellurite, as well as, 5% sucrose and

B. Cadmium Flouride Acriflavine Tellurite (CFAT) medium supplemented with sheep blood for the culture of Streptococcus mutans and Actinomyces species respectively. [13]

C. Mitis Salivarius Agar (MSA) *** is a selective medium for Streptococcus Mutans bacteria, which utilizes high saccharose and vital dyes (ie, crystal violet and bromphenol blue) as selective agents.

The medium was prepared according to manufacturers' instructions (90 grams of the medium were dissolved in 1L of distilled water by heating).Then the medium was sterilized for 15 min by autoclaving at 121°C then it was cooled to 50-55ºC, then it was supplemented with potassium tellurite.*

1 ml of 1% aqueous potassium tellurite was added to 1 L of mitis salivarius agar prior to pouring of plated medium. To select and enumerate the subgroup of Streptococcus *mutans*, mitis salivarius agar including potassium tellurite, was also

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* Ash, Dentsply, USA.
** Difco Laboratories, Detroit, Mich.
*** (Difco, Becton,Dickinson and company)
**** (Difco, Becton, Dickinson and Company)

augmented with bacitracin (10 units/ml., supplied in lyophilized form)*.[14]

The plates were then stored at 4°C according to the manufacturer's instruction.

A. Cadmium Sulfate Fluoride Acridine Trypticase Agar (CFAT) was formulated for the enhanced isolation of Actinomyces species from mixed culture. [15] Tryptic Soy and glucose form the nutritive base of this medium, which was supplemented with cadmium sulfate, sodium fluoride, neutral acriflavine, potassium tellurite, basic fuchsin and defibrinated sheep blood to enhance the isolation of A. naeslundii and A. viscosus.

The mixed culture was prepared at the Microbiology and Immunology Department, Faculty of Medicine, Ain Shams University with proportions of the fore mentioned constituents devised by (L J Zylber and H V Jordan).[16]Similarly, the poured plates were refrigerated and set aside until usage.

IV. The plates were then incubated using anaerobic gas pack system with anaerobic kits for 72 hours at 37ºC. **.[14]

V. S. mutans and Actinomyces spp. colonies were identified and the total viable counts were identified as colony forming unit/ml (cfu/ml) on MSA and CFAT agar respectively.

RESULTS

As regards to the G group there was no statistically significant change in mean (PI) score after 1 month. But From 3 months to 6 months, there was a statistically significant increase in mean PI score. From 6 months to 9 months, there was no statistically significant change in mean PI scores. Nine months score was significantly higher than

* (Sigma Chemical, St. Louis, Mo)
** (Anaerobic systems BR0038, Oxoid)

pre-operative score.While at F site; there was no statistically significant change in mean (PI) score after 1 month as well as 3 months. After 6 months, there was a statistically significant increase in mean PI score. From 6 months to 9 months, there was no statistically significant change in mean PI score. However, 9 months score was significantly higher than pre-operative score. (Table1)

TABLE (1): Mean ± standard deviation (SD) values and results of comparison of (PI) scores between different time periods at each site

Site / Time	C	G	F
Pre-operative	0.12 ± 0.29 [b]	0.22 ± 0.31 [d]	0.10 ± 0.20 [b]
1 month	0.09 ± 0.24 [b]	0.23 ± 0.25 [c]	0.10 ± 0.19 [b]
3 months	0.09 ± 0.18 [b]	0.54 ± 0.35 [b]	0.19 ± 0.33 [b]
6 months	0.18 ± 0.30 [a]	0.65 ± 0.25 [a]	0.29 ± 0.30 [a]
9 months	0.23 ± 0.33 [a]	0.52 ± 0.35 [a]	0.28 ± 0.28 [a]
P-value	0.001*	<0.001*	0.002*

*: Significant at P ≤ 0.05, Different superscripts in the same column are statistically significantly different

Pre-operatively, after 1 month as well as after 3 months, G group showed the highest statistically significant mean GI scores. There was no statistically significant difference between control teeth and F group scores; both showed the lowest mean GI scores. After 6 months as well as 9 months; G group showed the highest statistically significant mean GI scores. F group showed a statistically significant lower mean score. Control sites showed the lowest statistically significant mean GI score. (Table 2)

TABLE (2): Mean ± standard deviation (SD) values and results of comparison of (GI) scores between different scoring sites

Site\Time	C	G	F	*P*-value
Pre-operative	0.04 ± 0.13 [b]	0.16 ± 0.25 [a]	0.06 ± 0.17 [b]	0.004*
1 month	0.04 ± 0.13 [b]	0.56 ± 0.36 [a]	0.06 ± 0.17 [b]	<0.001*
3 months	0.02 ± 0.07 [b]	0.69 ± 0.30 [a]	0.07 ± 0.17 [b]	<0.001*
6 months	0.11 ± 0.26 [c]	0.7 ± 0.35 [a]	0.26 ± 0.38 [b]	<0.001*
9 months	0.15 ± 0.29 [c]	0.82 ± 0.28 [a]	0.28 ± 0.36 [b]	<0.001*

: Significant at P ≤ 0.05, Different superscripts in the same row are statistically significantly different

Microbiological analysis

As regards to bacterial counts, a logarithmic transformation (Log_{10} transformation) was performed to normalize the data before statistical evaluation because of the high range of bacterial counts.

Repeated measures ANOVA was used to compare between Log_{10} of bacterial counts at the sampling sites (C, F & G sites). Paired t-test was used to study the changes after treatment at each site.

A. Strept. mutans (S. mutans) counts

1. Comparison of the mean Log_{10} CFU of Strept. mutans counts between the sampling sites:

Pre-operatively as well as post-operatively, there was no statistically significant difference between the three sites in the mean Log_{10} CFU of Streptococci counts. (Figure, 5)

2. Changes in mean Log 10 CFU of S. mutans counts by time at each site:

At the control, GI as well as at the F sampling sites; there was no statistically significant change in mean Log_{10} CFU of Streptococci counts. (Figure 6)

B. Actinomyces spp. counts

1. Comparison of the mean Log_{10} CFU of Actinomyces counts between the sampling sites:

Pre-operatively as well as post-operatively, there was no statistically significant difference between the three sites in the mean Log_{10} CFU of Actinomyces spp. counts. (Figure 7)

2. Changes in mean Log_{10} CFU of Actinomyces spp. count by time at each site:

At the three groups there was no statistically significant change in mean Log_{10} CFU of Actinomyces spp. counts. (Figure 8)
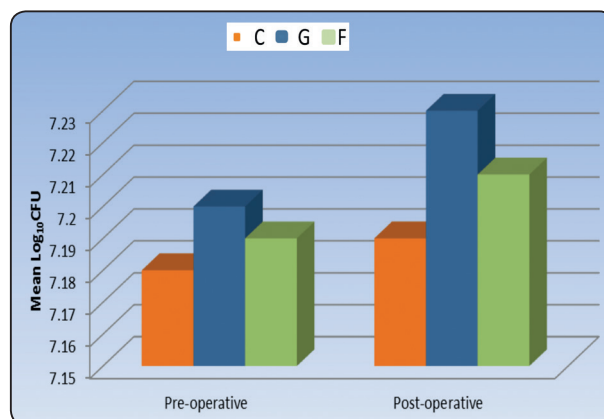

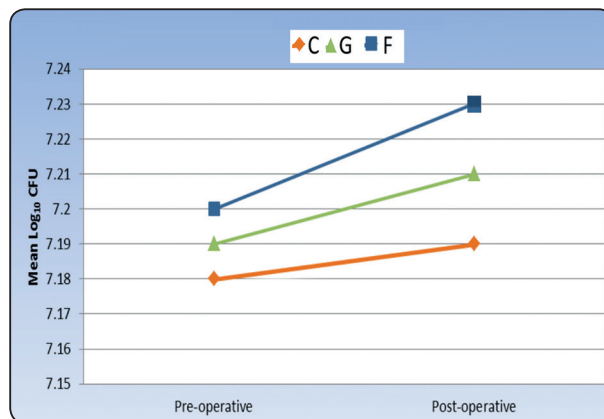Fig (5): Bar chart representing mean Log_{10} CFU of S. mutans in the three sites

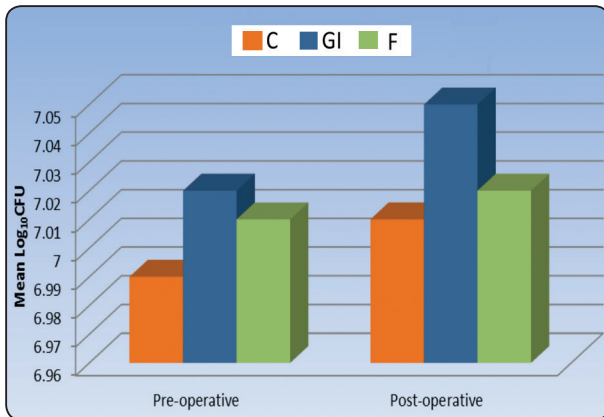Fig. (6): Line chart representing changes by time in mean Log_{10} CFU of S. mutans counts

Fig (7): Bar chart representing mean Log_{10} CFU of Actinomyces spp. at the three sampling sites
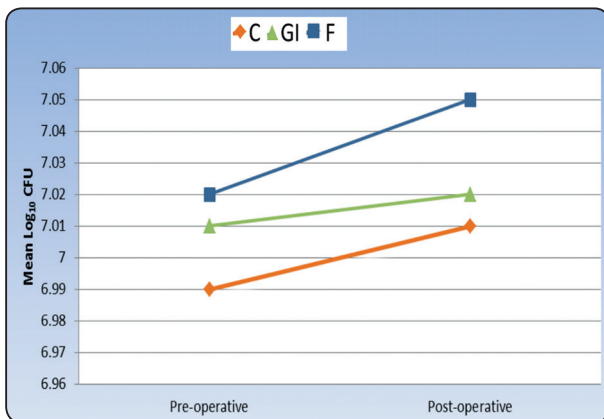

Fig (8): Line chart representing changes by time in mean Log_{10} CFU of Actinomyces spp. counts

DISCUSSION

Resin composites and glass ionomer have become popular for the restorations of primary anterior and posterior teeth. This may be due to their low relative thermal conductivity, preservation of the tooth structure in cavity preparation, the stability of their composition and because of the parents will to provide esthetic restorations to their children.

Differences in initiation of gingivitis or plaque formation between different restorative materials and non-restored tooth surfaces can be caused by many factors or by a combination between them. That is why the aim of this study was to investigate plaque retention and the condition of the gingiva adjacent to class V cavities restored with glass ionomer versus composite restoration and to compare the initiation of gingivitis around these restorations with that around enamel within nine month intervals.

The use of restorative materials having antibacterial activity in treatment of caries is of great importance. The chemical composition of glass ionomer together with its low pH during binding, and the release of fluoride are characteristics of its antibacterial effect.[4]

As regards to the G there was no statistically significant change in mean (PI) score after 1 month and from 6 months to 9 months. But although glass-ionomer restoration had more positive clinical and theoretical effects (good marginal adaptation, reduced surface roughness, aluminum and fluoride release that may interfere with bacterial adhesion and inhibit bacterial metabolism) on the subgingival biofilm composition than composite it showed a statistically significant increase From3 months to 6 months in mean PI score and nine months score was significantly higher than pre-operative score than control and Fgroup and this goes with the studies done by Santos et al.and Forss et al. this can be explained by its rough dental surfaces than composite which favors plaque formation due to increased surface area and a diminished cleaning efficiency of oral hygiene.[17],[18]

While at F site; there was no statistically significant change in mean (PI) score after 1 month as well as at 3 months and from 6 months to 9 months. While after 6 months, 9 months there was a statistically significant increase in mean PI score than pre-operative score. Similarly, Willershausen et al. (2001) reported a high prevalence of gingival bleeding and an increased Probing depth in association with resin-based restorations, as compared with other restorative materials. [19]

G group showed the highest statistically significant mean GI scores after 3, 6 and 9 months, while there was no statistically significant difference

between control and F group scores. Control sites showed the lowest statistically significant mean GI score. The results of the glass ionomer cement restorations obtained in the present study are not in agreement with those from other studies done by van Dijken & Sjöstro 1991 which showed the absence of detrimental effects on the gingiva by glass ionomer cement restorations if they were carefully contoured and finished). [20]

Controversial data are available on the effects of composite resin restorations on gingival health. As it was reported that More frequent inflammatory processes of the gingiva in the presence of composite resin restorations, but these was in comparison to metal restorations.[21]

Konradsson K et al. (2007) observed similar results to our findings: that well-finished and contoured composite resin restorations do not affect the health of the gingiva. However, longer observation of old composite resin restorations reported a significantly higher rate of gingival inflammation. This was explained by the surface deterioration that occurs in composite resin restorations after in vivo wear, with a consequent increase in plaque accumulation. [22#

Pre-operatively as well as post-operatively, there was no statistically significant difference between the three sites in the mean Log_{10} CFU of Streptococci counts and of Actinomyces spp. counts.and this goes with the study done by Paolantonio M et al. and the cross-sectional study done by van Dijken et al. (1991) which described a similar colonization by S. mutans and lactobacilli on 1-year-old glass ionomer cement and composite resin restoration. [23]

CONCLUSION

No statistically significant difference were seen in plaque and gingival index scores between the materials used at the first three months but there was increase in plaque and gingival index scores in Fuji IX group after three months till nine months intervals. At the enamel surface, as well as at Fuji

IX and resin composite sampling sites; there was no statistically significant change in mean Log10 CFU of Streptococci counts and Actinomyces spp. counts.

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