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Three-year clinical evaluation of two nano-hybrid giomer restorative composites

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Abstract

Purpose: To evaluate the clinical performance of two nano-hybrid giomer restorative composites; Beautifil II and Beautifil Flow Plus F00 with FL-Bond II adhesive system in class I posterior restorations during three-year period.
Materials and methods: Twenty patients joined this study with age ranging from 20 to 35 years. Each patient has to present two permanent upper or lower molars of the same side requiring new class I restorations of primary carious lesions to be restored by both tested materials. Two clinicians examined the twenty patients with 40 restorations (20 for each restorative material) clinically using Modified USPHS/Cvar & Ryge Criteria for direct restoration for a period of three years with an examination interval 6 months.
Results: Data was collected and statistically analyzed using SPSS version 18. Friedman's test showed no significant changes to all modified USPHS criteria for each material during the three-year evaluation period. Fisher's exact test showed no significant changes between materials in postoperative sensitivity, recurrence of caries or retention of restoration. The significant changes recorded were after three years period follow up between the two materials; Beautifil flow plus F00 has significantly better marginal adaptation ($P < 0.01$), marginal discoloration ($P = 0.01$), surface roughness ($P = 0.01$) and surface morphology ($P < 0.01$) versus Beautifil II.
Conclusion: Beautifil Flow Plus F00 (zero flow) restorative material achieved clinically better significant acceptable results than Beautiful II after three years of service in conservative class I cavities.

Keywords: Clinical evaluation; Class I; Beautifil II; Beautifil Flow Plus F00

1. Introduction

Composite restorations have become the most popular tooth colored direct filling materials. It has good esthetic, physical and mechanical properties compared to other direct esthetic restorative materials [1]. However, detected recurrent caries have been identified as a primary cause for replacement of directly placed resin composite restorations [2]. Restoration replacement is destructive for teeth containing a tooth colored restorations as it can result in an increase in cavity size by up to 37% [3].

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Table 1
Materials used in the study.

Giomer material description	Material name	Composition	Manufacturer & website
A nano-hybrid composite with fluoride release and recharge	Beautifil II	*Base resin*: Bis-GMA (7.5 wt%)/TEGDMA (5 wt%) resin *Filler*: Multifunctional glass filler and S-PRG (Surface Pre-Reacted Glass-ionomer) filler based on fluroboroaluminosilicate glass. *Filler loading*: 83.3 wt% (68.6 vol%) *Particle size range*: 0.01–4.0 μm *Mean particle size*: 0.8 μm DL-Camphorquinone	Shofu, Kyoto, Japan. www.shofu.com
A flowable nano-hybrid composite with fluoride release and recharge	Beautifil Flow Plus. F00	*Base resin*: Bis-GMA (15 wt%)/TEGDMA (13wt%) resin *Filler*: Multifunctional glass filler and S-PRG filler based on fluroboroaluminosilicate glass. *Filler loading*: 67.3 wt% (47.0 vol%) *Particle size range*: 0.01–4.0 μm *Mean particle size*: 0.8 μm DL-Camphorquinone	
A self-etching fluoride releasing two step adhesive system	FL-Bond II	*Primer*: Carboxylic acid monomer, Phosphonic acid monomer, 6-MHPA, Water, Solvent, Photo-initiator *Adhesive*: HEMA, UDMA, TEGDMA, 40% fluoride releasing and recharging S-PRG filler, Photo-initiator.	

Bis-GMA: bisphenol-A-diglycidyl methacrylate; TEGDMA: triethyleneglycol dimethacrylate; 6-MHPA: 6-methacryloxyhexyl 3-phosphonoacetate; HEMA: 2-hydroxylethyl methacrylate; UDMA: urethane dimethacrylate; S-PRG filler: Surface pre-reacted glass-ionomer filler.

It was found that; conventional glass ionomer (GI) has the ability to inhibit the initiation and progression of recurrent caries' [4]. This has stimulated scientists to develop a hybrid of composite and GI. Compomer and Resin modified glass ionomer (RMGI) have been developed to hybridize the advantages of both, the good mechanical properties, esthetic and hydrophopocity of composite added to anticariogenic activity and chemical bonding to tooth structure of GI advantages. However, properties of RMGI and compomer were still far from that of composite restoration [5,6].

Thus, Giomer material has been introduced as the true hybridization of glass ionomer and composite resin, containing surface pre-reacted glass ionomer (S-PRG) filler particles within a resin matrix. Giomer combines the fluoride release, recharge of GIs and the esthetics, physical and handling properties of composite resins [7].

Literature search reveals several clinical studies conducted on giomers in class V and in class I, II lesions over a period of 1–8 years with good clinical performance [8–13]. Yap et al. [13] found that a giomer, after polishing with Sof-Lex disks, had a smoother surface than a glass ionomer, and one that was comparable to that of a compomer and a resin composite. Jyothi et al. [14] reported that Beautifil II (a second giomer generation) had superior surface finish compared to RMGIC (Fuji II LC) in non-carious cervical lesions in one year clinical study. Moreover, a clinical study [15] has reported no significant difference between Beautifil II giomer restorative material and a conventional resin-based composite material. These results encouraged the manufacturer[1] to develop flowable giomer materials with different viscosities. Beautifil Flow Plus F00 is one of the flowable giomer products which claimed by the manufacturer to have favorable adaptation, effortless delivery with the strength, durability and aesthetics equal to or better than hybrid composites.

The current study offered the opportunity to clinically compare two nano-hybrid giomer restorative materials employing the same composition but with different fillers percentage. Both materials depend on multifunctional glass filler and S-PRG filler based on fluroboro-alumino silicate glass with particle size range from 0.01 to 4.0 μm. The filler content are 83.3 wt% (68.6 vol%) in Beautifil II and 67.3 wt% (47.0 vol%) in Beautifil Flow Plus F00.

The research null hypothesis was that there is no difference in the clinical performance of Beautifil II and Beautiful Flow Plus F00 in conservative class I cavities.

[1] Shofu, Kyoto, Japan.

2. Materials & methods

The materials used in this study are shown in Table 1. Two giomer restorative composites; Beautifil II[1] and Beautifil flow Plus F00[1] were compared in class I posterior restorations during three years period.

2.1. Patient selection

Twenty patients joined this study with age ranging from 20 to 35 years (mean: 27.5 year). Each patient received two conservative classes I with primary carious lesions restored by the two tested restorative materials at one side whether upper or lower molars. Patients must have molar-supported permanent dentition and no clinically significant occlusal interference. Patients with poor oral hygiene sever or chronic periodontitis or any para-functional habit, abnormal occlusion or any regurgitation problem were excluded from this study. The specific exclusion criteria included pulpitis, non-vital, fractured or visibly cracked or stained teeth and defective restorations adjacent to or opposing to the selected tooth. Patients were selected from dental clinic of Conservative Dentistry Department at Faculty of Dentistry of Tanta University in Tanta, Egypt. The nature and objectives of the study as well as all restorative procedures were explained to the patients. Written informed consents approved by Research Ethics Committee in Tanta University were obtained from all patients prior to treatment. All patients had oral prophylaxis treatment and oral hygiene instructions two weeks before the placement of restorations, and when needed they were referred to Periodontology department, Faculty of Dentistry of Tanta University.

2.2. Clinical procedures

Selected teeth were prepared and restored by a single clinician from the research team using Beautifil II composite (group I) and Beautifil flow plus F00 composite (Group II).

Appropriate (Mepivacaine Hcl 2% with levo-nordefrine 1:20,000)[2] local anesthesia had been achieved preoperatively, unless declined by the patient. Shade of each tooth to be restored was recorded while the tooth is moist. Class I cavity preparation was limited according to extension of caries. Cavities were prepared by #57 straight plain carbide fissure bur,[3] held in high speed contrangle hand piece with water cooling system. All internal line angles were slightly round. Each bur was discarded after five preparations. The average facio-lingual width of the cavities was approximately one-third of the intercuspal width. No beveling was performed. If deep caries was found, soft carious dentin was removed with spoon excavator and hard carious dentin was removed with large round bur at a low speed hand piece with water coolant system free of oil. The prepared tooth was isolated with rubber dam. Calcium hydroxide[4] was placed, wherever indicated, restricted at deep spots only after caries removal.

FL-Bond II adhesive[1] was applied at both groups, for both giomer composite materials according to manufacturer's instructions.

The primer was applied on enamel and dentin and left undisturbed for 10 s, dried with oil-free air, and then an even layer of bonding agent was applied on the entire cavity and light-cured for 10 s with halogen light curing unit.[5] Composite restorations were placed according to manufacturer's instructions. The proper shade of composite was selected, inserted and adapted with a flat-faced condenser into each occlusal cavity in 2 mm increment and light cured for 20 s with the halogen light curing unite. The light output of the curing unit was monitored to ensure the intensity using a light meter.[6] Excess composite was finished and polished by “Dura White stones” and One Gloss Set.[1]

Two investigators examined 20 patients with 40 restorations (20 for each restorative material) using mirror and explorer under good operating light at one week (baseline) and each 6 months interval up to 3 years using modified U.S. Public Health Service (USPHS)/Cevar & Ryge criteria [16]. Marginal adaptation, marginal discoloration, surface roughness, surface morphology, postoperative sensitivity, retention of restoration, and recurrence of caries criteria were evaluated blindly. The examiners were unaware of which restorative material had been used for any restoration and any discrepancy between examiners was resolved before the patient was dismissed. The disagreement ratio between the two clinicians was less than 3%. Intraoral color digital photographs were taken at each evaluation visit as a permanent record for subsequent evaluation and later reference. Periapical

[2] Alexandria Co. for pharmaceutical& chemical industries _Gamila Bohreid Road –Awayed - Alexandria Egypt.
[3] Dentsply, united Kingdom.
[4] Dycal, Dentsply Caulk, Milford, DE, USA.
[5] Curing Radiometer Model 100; Demetron Corp, Orange, Ca, USA.
[6] Cromalux, MEGA-PHYSIK, GmbH & COKG, Germany.

Table 2
No. of cases, scoring % and statistical analysis for marginal adaptation of tested groups at different follow up periods.

Parameters	Baseline no. 20		6 Month no. 20		12 Month no. 20		18 Month no. 20		24 Month no. 18		30 Month no. 18		36 Month no. 16		Friedman test	*P* value
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
GP I©																
Alpha	20	100	18	90	18	90	18	90	15	83.4	12	66.6	8	50	1	0.45
Bravo	0	0	2	10	2	10	2	10	3	16.6	3	16.6	4	25		
Charlie	0	0	0	0	0	0	0	0	0	0	3	16.6	4	25		
GP II®																
Alpha	20	100	20	100	20	100	20	100	16	88.9	16	88.9	12	75	1	0.45
Bravo	0	0	0	0	0	0	0	0	2	11.1	2	11.1	4	25		
Charlie	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Fisher exact *P* value	1		0.48		0.48		0.48		1		0.18		<0.01**			

**Highly significant at $P < 0.01$ value.
© GP1: Beautifil II.
® GPII: Beautifil Flow Plus F00.

Table 3
No. of cases, scoring % and statistical analysis for marginal discoloration of tested groups at different follow up periods.

Parameters	Baseline no. 20		6 Month no. 20		12 Month no. 20		18 Month no. 20		24 Month no. 18		30 Month no. 18		36 Month no. 16		Friedman test	*P* value
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
GP I©																
Alpha	20	100	18	90	18	90	18	90	15	83.4	15	83.4	8	50	1	0.45
Bravo	0	0	2	10	2	10	2	10	3	16.6	3	16.6	8	50		
Charlie	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
GP II®																
Alpha	20	100	20	100	20	100	20	100	17	94.45	17	94.45	14	87.5	0	1
Bravo	0	0	0	0	0	0	0	0	1	5.55	1	5.55	2	12.5		
Charlie	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Fisher exact *P* value	1		0.48		0.48		0.48		0.60		0.60		0.01*			

*Significant at $P > 0.05$ value.
© GP1: Beautifil II.
® GPII: Beautifil Flow Plus F00.

Table 4
No. of cases, scoring % and statistical analysis for surface roughness of tested groups at different follow up periods.

Parameters	Baseline no. 20		6 Month no. 20		12 Month no. 20		18 Month no. 20		24 Month no. 18		30 Month no. 18		36 Month no. 16		Friedman test	*P* value
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
GP I©																
Alpha	20	100	18	90	16	80	16	80	15	83.4	14	77.78	8	50	1	0.45
Bravo	0	0	2	10	4	20	4	20	3	16.6	4	22.22	8	50		
Charlie	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
GP II®																
Alpha	20	100	20	100	20	100	18	90	18	100	17	94.45	14	87.5	0	1
Bravo	0	0	0	0	0	0	2	10	0	0	1	5.55	2	12.5		
Charlie	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Fisher exact *P* value	1		0.48		0.11		0.66		0.23		0.19		0.01*			

*Significant at $P > 0.05$ value.
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® GPII: Beautifil Flow Plus F00.

Table 5
No. of cases, scoring % and statistical analysis for surface morphology of tested groups at different follow up periods.

Parameters	Baseline no. 20		6 Month no. 20		12 Month no. 20		18 Month no. 20		24 Month no. 18		30 Month no. 18		36 Month no. 16		Friedman test	*P* value
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
GP I©																
Alpha	20	100	20	100	20	100	18	90	17	94.45	15	83.4	10	62.5	1	0.45
Bravo	0	0	0	0	0	0	2	10	1	5.55	3	16.6	6	37.5		
Charlie	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
GP II®																
Alpha	20	100	18	90	16	80	16	80	14	77.78	14	77.78	12	75	0	1
Bravo	0	0	2	10	4	20	4	20	4	22.22	4	22.22	2	12.5		
Charlie	0	0	0	0	0	0	0	0	0	0	0	0	2	12.5		
Fisher exact *P* value	1		0.48		0.11		0.42		0.34		1		<0.01**			

**Highly significant at $P < 0.01$ value.
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® GPII: Beautifil Flow Plus F00.

Table 6
No. of cases, scoring % and statistical analysis for postoperative sensitivity of tested groups at different follow up periods.

Parameters	Baseline no. 20		6 Month no. 20		12 Month no. 20		18 Month no. 20		24 Month no. 18		30 Month no. 8		36 Month no. 16		Friedman test	*P* value
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
GP I©																
Alpha	20	100	20	100	20	100	20	100	18	100	18	100	16	100	0	1
Charlie	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
GP II®																
Alpha	18	90	18	90	20	100	20	100	18	100	18	100	16	100	0	1
Charlie	2	10	2	10	0	0	0	0	0	0	0	0	0	0		
Fisher exact *P* value	0.48		0.48		1		1		1		1		1			

© GP1: Beautifil II.
® GPII: Beautifil Flow Plus F00.

Table 7
No. of cases, scoring % and statistical analysis for retention of restoration of tested groups at different follow up periods.

Parameters	Baseline no. 20		6 Month no. 20		12 Month no. 20		18 Month no. 20		24 Month no. 18		30 Month no. 18		36 Month no. 16		Friedman test	*P* calue
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
GP I©																
Alpha	20	100	20	100	20	100	20	100	18	100	18	100	16	100	0	1
Charlie	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
GP II®																
Alpha	20	100	20	100	20	100	20	100	18	100	18	100	14	87.5	0	1
Charlie	0	0	0	0	0	0	0	0	0	0	0	0	2	12.5		
Fisher exact *P* value	1		1		1		1		1		1		0.48			

© GP1: Beautifil II.
® GPII: Beautifil Flow Plus F00.

Table 8
No. of cases, scoring % and statistical analysis for recurrence of caries of tested groups at different follow up periods.

Parameters	Baseline no. 20		6 Month no. 20		12 Month no. 20		18 Month no. 20		24 Month no. 18		30 Month no. 18		36 Month no. 16		Friedman test	*P* value
	No.	%	No.	%	No.	%	No.	%	No	%	No.	%	No.	%		
GP I©																
Alpha	20	100	20	100	20	100	20	100	18	100	18	100	160	100	0	1
Charlie	0	0	0	0	0	0	0	0	0	0	0	0		0		
GP II®																
Alpha	20	100	20	100	20	100	20	100	18	100	18	100	14	87.5	0	1
Charlie	0	0	0	0	0	0	0	0	0	0	0	0	2	12.5		
Fisher exact *P* value	1		1		1		1		1		1		0.48			

© GP1: Beautifil II.
® GPII: Beautifil Flow Plus F00.

X-ray were also performed at each visit to help recording any recurrence of caries.

The data for the tested criteria were collected, tabulated and statistically analyzed using statistical package for social science (SPSS) version 18 computer program. The level of significance was set at 95% value. Each tested criterion for each material was analyzed separately regarding different follow up periods using Friedman's test. Both tested materials (groups) were compared using Fisher's exact test since the difference between the two tested groups was small.

Twenty patients were available up to 18 months examination period. Only 18 patients were present at 24 and 30 months examination sessions. While 16 patients were present at 36 months follow up period.

3. Results

The number of patients, scoring %, Friedman's test and Fisher's exact test are presented in Tables 2–8 for the tested criteria at different follow up periods. Friedman's test showed no significant changes to all modified USPHS criteria for each material during the three-year evaluation period. Fisher's exact test showed no significant changes between materials in post-operative sensitivity, recurrence of caries or retention of restoration. The significant changes recorded were after three years period between the two materials; Beautifil flow plus F00 has significantly better marginal adaptation ($P < 0.01$), marginal discoloration ($P = 0.01$), surface roughness ($P = 0.01$) and surface morphology ($P < 0.01$) versus Beautifil II.

4. Discussion

Resin composite technology has undergone major developments over the last decades. These developments have been so rapid that long-term clinical data on specific product are rarely available, because of the regular introduction of “improved” versions. For example; first generation Beautifil giomer composite and FL-Bond adhesive was introduced in 2000 followed by a second generation Beautifil II and FL-Bond II adhesive in 2007, then shortly after Beautifil Flow Plus and more recently during this study bulk Flowable giomer was introduced. Although in vitro studies might provide in short time useful data regarding the potential performance of a material or the handling characteristic. These in vitro studies cannot answer questions about the in vivo longevity of these tooth-colored restorations [17]. Thus in vivo studies should not be neglected.

Currently, 3 years evaluation with 6 month interval was conducted, as the patients 'commitment to be followed up for longer time was difficult especially where there are no complaints. The response rate with respect to the recall examination was 100% for 6-month, 12-month and 18-month periods, 90% for 24-month and 30-month periods, and 80% for 36-month period, which is considered an acceptable response rate compared to previous clinical studies in restorative dentistry [8–15]. Notwithstanding this fact, the current results at 36-month must be interpreted with caution as the inclusion criteria limited the number of patients sharing this study, since each patient has to receive both restorative materials at the same side.

Giomers composite materials have been chosen in this study as it they provides the fluoride release and recharge of glass ionomers and the esthetics, physical properties and handling of composite resins [18,19]. In vitro studies concluded dentin remineralization occurs at the preparation surface adjacent to the giomer [20,21]. Further, S-PRG filler particles in giomer was reported to act as a fluoride reservoir that recharge with brushing or rinsing with fluoridated products [22–24]. Giomers form an acid-resistant film, resist plaque formation as it inhibit bacterial adhesion [24–26]. Because of their fundamental composite resin nature, giomers had superior surface finish than glass-ionomers [14] and RMGI [15]. Several clinical studies conducted on first generation Beautifil [8–15] and second generation Beautifil II [27] giomers in class V and in class I, II lesions over a period of 1–8 years reported acceptable clinical performance.

Beautifil Flowable Plus has been introduced after Beautifil II. The manufacturer claimed that they combine all the advantages of giomer science with the ease of use, handling and adaptability of flowable composites. Beautifil Flow Plus is claimed to be the ideal restorative material for the perimeter preparation. Flowable composite resins easily conforms to the intricate geometry of the narrow preparation without creating voids, has strength and wear resistance to withstand oral forces, is bacteriostatic and remineralizing to prevent secondary caries, and is radiopaque. Thus, the current clinical study compared both Beautifil II and Beautifil Flow Plus F00 in conservative class I cavities.

In the present study, the evaluation of marginal adaptation recorded 2 Bravo scores out of the twenty restorations of Beautifil II restorations at 6-month evaluation period had progressed to 3 Bravo and 3 Charlie cases out of 18 patients at 30-month follow up period, and increased up to 4 Bravo and 4 Charlie cases out of 16 patients at 36-month period. While in Beautifil Flow Plus F00 restorations, 2 Bravo scores appeared later after 24 month and increased up to 4 cases at 36 month-period without the presence of any Charlie scores. This was reflected statistically by Fisher's exact test reading a highly significant difference ($P < 0,01$) between both tested materials at 36-month-period with better performance of Beautifil Flow Plus F00. Similarly, a significant difference between the tested materials was reported only at 36 month-period for marginal discoloration ($P = 0,01$), surface roughness ($P = 0.01$) and surface morphology ($P < 0.01$). Although Beautifil II material has higher filler content than Beautifil Flow Plus F00, however favorable adaptation, effortless delivery and void free restoration of the flowable giomer products as claimed by the manufacturer might be the reason for this result especially in class I conservative restorations. High filler content without bonding of the resin with S-PRG filler might be responsible for decreased marginal adaptation and surface morphology, increased surface roughness and marginal discoloration in Beautifil II material. As S-PRG should not be silanized as other glass fillers present in giomer composite. So, S-PRG can release and recharge and rerelease fluoride ions. Recent in vitro study [28] in 2012 investigated the color stability of Beautifil II, two flowable (Beautifil Flow [F02, F10]) and two recently introduced flowable "plus" (Beautifil Flow Plus [F00, F03]). The least color change was generally observed with the flowable "plus" pre-reacted glass-ionomer containing composites. The authors attributed this result in part to relatively higher TEGDMA content in Beautifil Flow Plus compared to their conventional counterparts Beautifil II. TEGDMA maximized copolymerization with Bis-GMA. Moreover, Beautifil II had the highest filler loading; any dissolution of the resin matrix would lead to greater exposure of the irregularly arranged filler particles resulting in rougher surfaces which easily stained by mechanical absorption [29].

Marginal defects and/or marginal staining are signs of bond degradation [30] and fatigue of restorative materials due to repeated occlusal load and thermal stresses [31]. In the present study FL-Bond II adhesive was used for both restorative materials. Flowability of Beautifil Flow plus allows for better wetting along the cavity walls, thus improving adaptation of the restorative material to the cavity walls. In addition, flowable resin composite with low elastic modulus was reported to relieve the stresses at the adhesive interfaces generated by occlusal forces [31], since the flowable resin composite was able to flex with the tooth [32].

Placement of low elastic modulus materials can act as "elastic buffers," since they have sufficient flexibility to resist polymerization shrinkage stress and favorably dissipate stresses produced by thermal variations, water absorption and occlusal loads across the interface [33,34]. Some studies have shown an enhanced performance of composite restorations when an additional intermediate elastic layer was placed between the resin composite and dentin substrate. Stresses generated by the polymerization shrinkage of Filtek Z250 were significantly reduced when this composite was combined with Filtek-Flow [32]. A better dissipation of shrinkage stresses [35–37], lower microleakage [38,39] and improved marginal adaptation [35,40] has already been reported. These could or might be explanation of the current results of marginal adaption, marginal discoloration, surface roughness and surface anatomy criteria (Tables 2–5) with better performance of flowable material Beautifil Flow Plus than conventional Beautifil II material.

The effect of time was statistically analyzed by using Friedman's test for either material showing a non-significant difference for all criteria. Neither time nor materials was an effective variable concerning postoperative sensitivity criterion. However, postoperative sensitivity recorded 2 Charlie scores at the baseline and at 6-month period for Beautifil Flow Plus F00 which was converted to Alpha scores afterward to the end of the study at 36-month period. This recorded postoperative sensitivity could be attributed to initial hyperemic pulp at the baseline which disappeared after 6-month follow up period.

Although the effect of time and material factors were not significant evaluating the recurrence of caries and retention of tested restorations. After 36-month period, Beautifil II recorded 100% Alpha scores. Testing Beautifil Flow Plus F00, the recorded results showed 87.5% alpha scores (14 out of 16 cases) and 12.5% Charlie scores showing 2 failed restorations which have to be replaced. This might explained as; unlike glass-ionomer, giomer do not have the initial burst of release, and its long-term release was lower than that of conventional glass-ionomer [41]. Teranaka et al. [42] reported that Beautifil has a fluoride release of 25% of that provided by conventional glass ionomer cement. Beautifil Flow Plus F00 which contains less S-PRG could release less fluoride than original giomer Beautifil material. Another explanation might attribute this current failure to the presence of deep caries estimated by the periapical x-rays. So it may be referred to the incomplete removal of caries during cavity preparation. Thus, it is recommended to use recent diagnostic tools to ensure the whole removal of infected dentin concerning the conservative preparations.

The appearance of significance differences between materials only at the end of this study at 3-year period and piercing of two failed cases of Beautifil Flow Plus F00 due to caries recurrence suggested the importance of extending the follow up period for more accurate comparison of these restorations.

No clinical studies reported the use of Beautifil Flow plus giomer in class I or II restorations. In agreement with this part in the present study, at two [8,10], three [11], four [9] and eight years [12] clinical studies of class I and II of first generation Beautifil and 18-month [27] clinical study of second generation Beautifil II giomer restorations, none of the restorations failed, no sensitivity was reported, and most notably, no secondary caries were present in any of the patients. In these studies marginal adaptation and marginal staining constitute the majority of changes without any Charlie ratings. However, in the present study 25% Charlie cases were reported for marginal adaptation of Beautifil II restoration in class I at 3-year follow up period.

By the end of this research it was concluded that, the null hypothesis was rejected, as Beautiful Flow Plus F00 restorative material achieved clinically better acceptable results than Beautiful II after three years of service in conservative class I cavities.

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