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RESEARCH ARTICLE

EFFECT OF BEVERAGES ON THE MARGINAL INTEGRITY OF CLASS V TOOTH PREPARATION RESTORED WITH ALKASITE MATERIAL AND HIGHLY FILLED FLOWABLE COMPOSITE RESIN: AN IN VITRO STUDY

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ABSTRACT

Objective: To evaluate microleakage of Alkasite material (Ivoclar vivadent) and Highly filled flowable composite resin (GC corporation Tokyo, Japan) restorations,immersed in tea, fresh fruit juice and carbonated drink. ***Materials and Methods:*** Fourty caries free extracted mandibulars molars were used for the study. Class V cavities were prepared and restored with Alkasite material on the buccal surface and highly filled flowable composite resin on the lingual surface. The teeth were thermocycled following the restoration. The experimental groups comprised of 72 cavities (3 groups comprising 24 cavities each for tea, fresh fruit juice and carbonated drinks), while remaining 8 formed the control group. Each of experimental group was further divided into three subgroups (low, medium and high immersion).The teeth were finally immersed in Methylene Blue dye, sectioned and evaluated under stereomicroscope. Results: The teeth showed statistically significant microleakage as the immersion regime increased. Carbonated drink group showed highest microleakage followed by fresh fruit juice and tea. Highly filled flowable composite resin exhibited more microleakage than the alkasite material but the comparison was not statistically significant. ***Conclusion:*** The three beverages used in the study affected the microleakage of both restorative materials significantly. The microleakage scores increased as the frequency of the immersions increased. Soft drink caused highest microleakage followed by fresh fruit juice and tea.

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INTRODUCTION

The concept of health has prevailed for centuries and dietary habits are apparently changing with innovation.

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It has been reported that contemporary fluid consumption patterns of children and youngsters are now more diverse than in past years, since carbonated soft drinks and fruit juices have replaced much of the prior consumption of water and milk among adolescents (Harnack, 1999). Over the past years esthetic dentistry has shown considerable progress leading to the growth of a number of improved restorative materials. Currently, the main concerns regarding the performance of these materials refers to their durability and the integrity of

marginal seal. Microleakage is defined as the clinically undetectable passage of bacteria, fluids, molecules or ions between tooth and the restorative material (EAM, 1976). Excessive contact of tooth structure with acidic fluids leads to loss of dental hard tissue. Thus, it can be assumed that restorative material when subjected to low pH environment in oral cavity, leads to deprivation of its surface and marginal integrity (Bränström, 1976). The Cention N (Ivoclar Vivadent) is an "alkasite" tooth coloured, basic filling restorative material.This category utilizes an alkaline filler, capable of releasing acid-neutrilizing ions. Cention N releases ions such as OH^-, Ca^{++}, Fl^- depends upon pH value in oral cavity, when pHvalue is low, it releases a significantly larger ions than when the pH value is neutral. Cention N a newly introduced restorative alkasite material is resin based with characteristics of both silver amalgam and GIC. The manufacturers claim advantages over the existing materials. It consists of an alkaline filler which release acid neutralizing ions – fluoride, calcium and hydroxide ions. Organic monomer comprises of urethane dimethacrylate (UDMA), tricylodecan-dimethanol dimethacrylate (DCP), tetramethyl-xlylen-diurethane dimethacrylate (aromatic aliphatic-UDMA) and polyethylene glycol 400 dimethacrylate (PEG-400 DMA) which form part of the liquid. Fillers containing barium aluminium silicate glass, ytterbium trifluoride, Isofiller, calcium barium aluminium fluorosilicate glass, calcium fluoro silicate glass are found in the powder.

G-aenial Universal Flo (GC CORPORATION TOKYO, JAPAN) is a truly injectable highly filled flowable composites that is strong, polishable and wear resistance less than conventional composite. Sailanation technology was a key aspect of the new material development. The aim of the present study was to evaluate the marginal integrity in class V cavity filled with flowable composite resin and Cention N. Null hypothesis- There is no difference in the marginal integrity of Cention-N and G-aenial universal flo when immersed in low, medium and high immersion regimes of different drinks.

AIM: To evaluate microleakage around Class V cavities restored with Cention –N an alkasite material and G-aenial Flo as highly filled flowable composite immersed in artificial saliva, tea, carbonated drinks and fresh fruit juice (sweet lime).

OBJECTIVE

- To evaluate the effect of tea, carbonated drinks and fruit juice on the microleakage.
- To evaluate the effect of different immersion regimen on the microleakage.
- To compare the microleakage between alkasite material and highly filled flowable composite resin.

METHODOLOGY

Forty extracted human permanent mandibular molars which were free of caries and cracks were selected. Class V cativies were prepared with a dimension of 3mm in length, 2mm in width and 2mm in depth. 80 cavities were prepared on fourty teeth, one on buccal aspect restored with Cention – N and another on lingual aspect restored with G-aenial Flo. They were subjected to 200 thermocycles between 5 degree celcius and 55 degree celcius.

Dwell time was 1 min with 10 seconds transit between baths (4). Out of eighty restorations, seventy two restorations were equally divided into three groups of 24 each restoration as experimental group while remaining eight restorations formed the control group which was given in table 1. All the groups were immersed as follows:

Group I- Tea (it was prepared by adding one teaspoon tea dust to 160 ml of water by boiling for 5 minutes, cooled it and then used

Group II - Sweetlime (it was extract freshly before each immersion)

Group III –Ccarbonated drinks- Coca Cola (Coca Cola Co, Kerala)

Group IV- Artificial saliva (it was prepared in the department of Biochemistry, Swargiya Dadasaheb Kalmegh Smruti Dental College).

Then each of experimental groups were further divided into three subgroups as low, medium and high. For low immersion regime the restorations were subjected to one immersion lasting five minutes per day. For medium immersion regime they were subjected to 5 immersions per day. For high immersion regime the samples were subjected to 10 immersions per day. Each immersion lasted for five minutes, and the immersions were evenly distributed over a 12 hour period. The whole procedure was carried out for 8 days. Before and after each immersion the samples were copiously rinsed in 0.1M phosphate buffered saline (pH 7.2). When not exposed to the immersion regime, they were stored in deionised water at room temperature (Maupome, 1998). The teeth were then immersed in methylene blue solution for 24 hours, rinsed, dried, and invested in clear resin. Each tooth was sectioned bucco-lingually through the centre of the restoration with help of a low speed water cooled diamond disc (GSS Germany). The specimens thus obtained were examined under 40X magnification in stereomicroscope (*Motic Co. SMZ-143 series*) to evaluate the microleakage. Dye penetration was graded based on the extent of penetration along the walls of the restoration. This was scored using criteria similar to the one used by Staninec and Holtz (1988) (Staninec, 1998).

Scores:

Score1: No dye penetration.
Score2: Dye penetration along occlusal wall but less than half way to axial wall.
Score3: Dye penetration along occlusal wall but more than half way to axial wall.
Score4:Dye penetration along occlusal wall upto and along axial wall.

RESULTS

The results and observations of microleakage were summarized as follows:

Cention-N: The frequency, mean score and median of all groups in Cention-N is depicted in table 2

Intragroup Comparison: When specimens were compared between the three immersion regimes, all the specimens scored higher microleakage as the number of immersion intervals

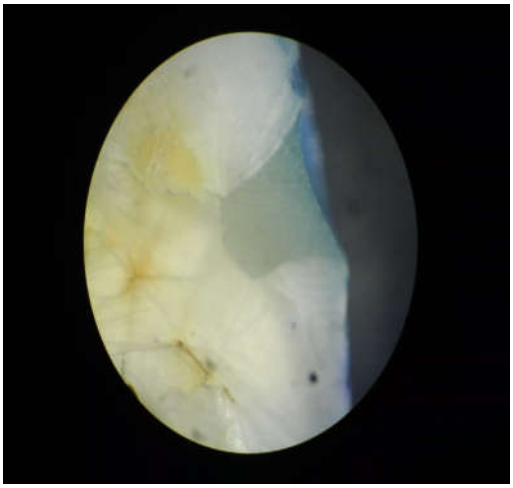


FIGURE 1 SCORE O Under 40X magnification

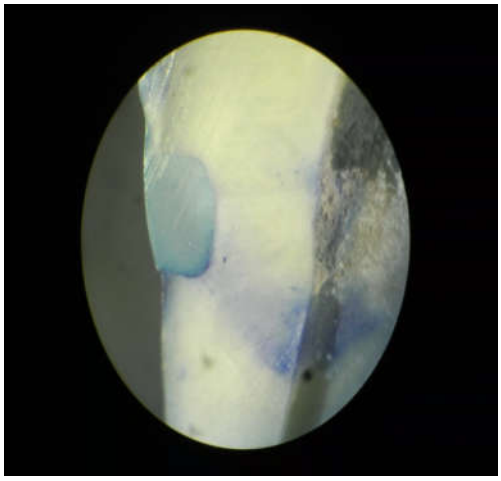


FIGURE 2 SCORE 1 Under 40X magnification

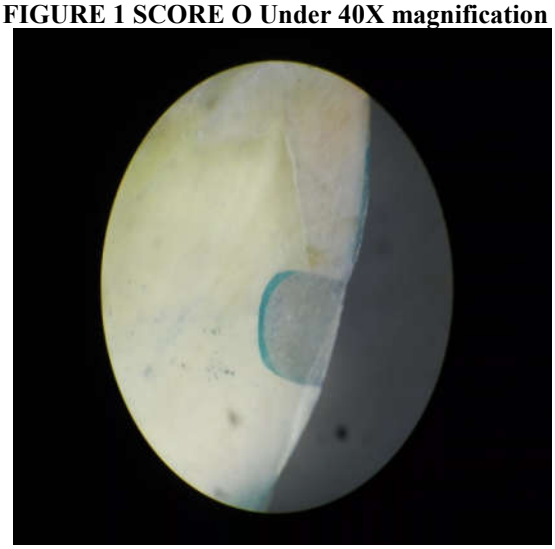


FIGURE 3 SCORE 2 Under 40X magnification

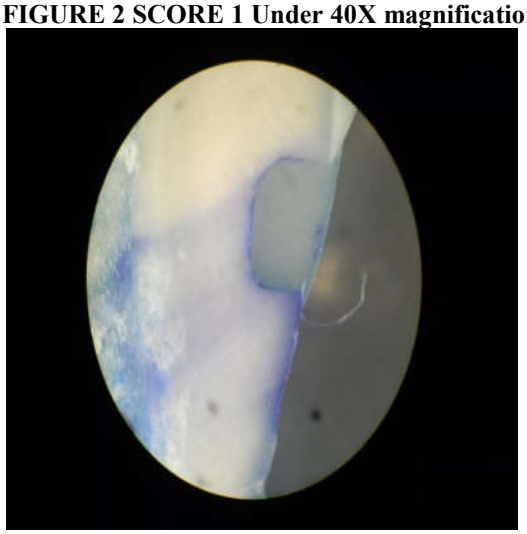


FIGURE 4 SCORE 3 Under

Table 1. Distribution of samples in the group and subgroup

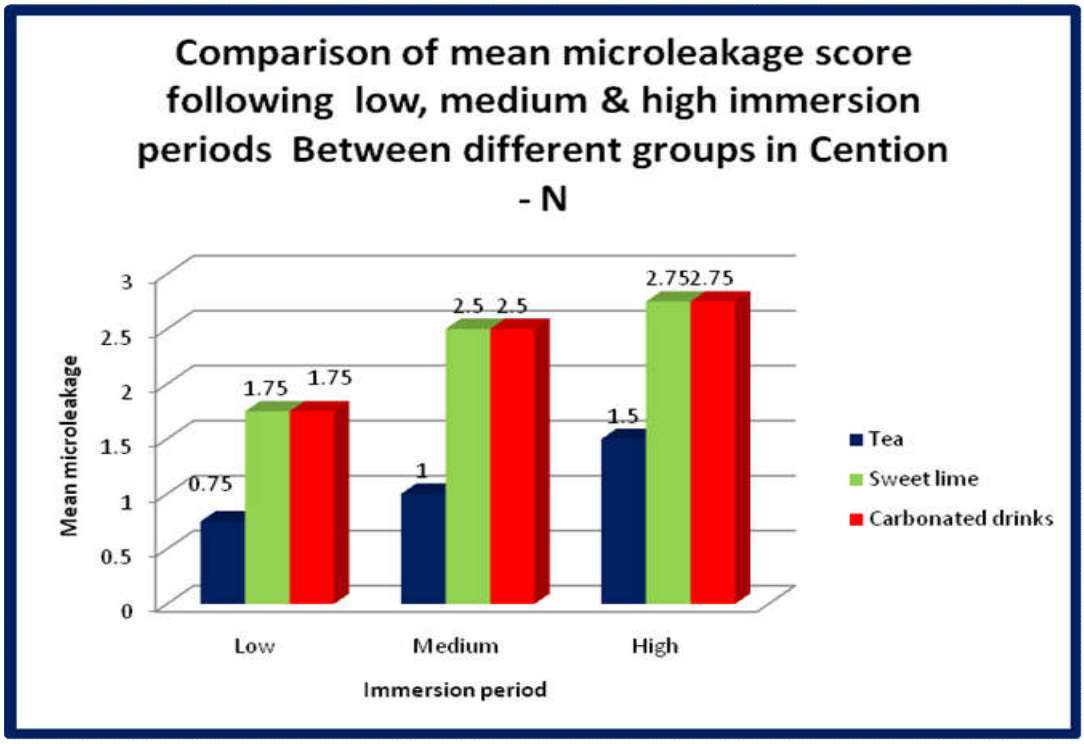
GROUPS	MATERIALS	SUBGROUPS		
		LOW	MEDIUM	HIGH
Group I	Cention-N	4	4	4
Tea	G-aenial universal flo	4	4	4
Group II	Cention-N	4	4	4
Sweetlime	G-aenial universal flo	4	4	4
Group III	Cention-N	4	4	4
Carbonated drinks	G-aenial universal flo	4	4	4
Group IV	Cention-N	4		
Artificial saliva	G-aenial universal flo	4		

Table 2. Descriptive statics on the microleakage pattern of Cention-N for varying periods of time in Tea, Sweetlime, Carbonated drinks and control group

Tea	0	1	0	0
	1	3	4	2
	2	0	0	2
	3	0	0	0
Mean		0.75	1	1.5
Median		1	1	1.5
Sweetlime	0	0	0	0
	1	1	0	0
	2	3	2	1
	3	0	2	3
Mean		1.75	2.5	2.75
Median		2	2.5	3
Carbonated drinks	0	1	0	0
	1	1	0	0
	2	0	2	1
	3	2	2	3
Mean		1.75	2.5	2.75
Median		2	2.5	3
		No immersion regimen		
Control Group	0	3		
	1	1	Mean 0.12	
	2	0	Median 0	
	3	0		

Table 3. Intragroup comparison for Cention-N showing p-value (S-significant, NS-not significant)

Group	Low vs Med	Med vs High	Low vs High
Tea (Group I)	P=0.12 NS	P=0.08 NS	P=0.04 S
Sweetlime (Group II)	P=0.03 S	P=0.12 NS	P=0.01 S
Carbonated drinks (Group III)	P=0.01 S	P=0.14 NS	P=0.02 S



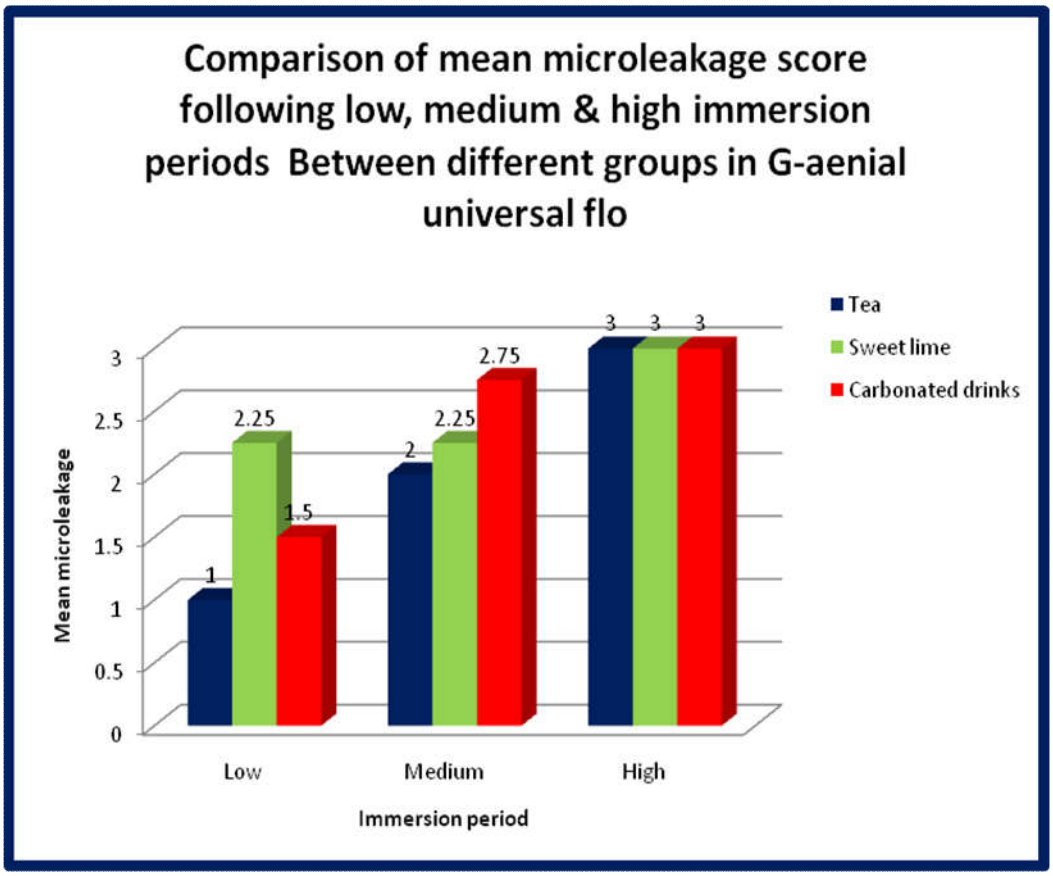


Table 4. Descriptive statics on the microleakage pattern of G-aenial Universal Flo following immersion for varying periods of time in Tea, Sweetlime, Carbonated drinks and control group

G-aenial Universal Flo			
Groups	Low	Medium	High
Tea 0	2	0	0
1	0	0	0
2	2	4	0
3	0	0	4
Mean	1	2	3
Median	1	2	3
Sweetlime 0	0	0	0
1	1	1	0
2	1	1	0
3	2	2	4
Mean	2.25	2.25	3
Median	2.5	2.5	3
Carbonated drinks 0	0	0	0
1	2	0	0
2	2	1	0
3	0	3	4
Mean	1.5	2.75	3
Median	1.5	3	3
Control group 0	3		
1	1		
2	0		
3	0		
Mean	0.12		
Median	0		

Table 5. Intragroup comparison for Cention-N showing p-value (S-significant, NS-not significant)

	Low vs Med	Med vs High	Low vs High
Tea	0.03	0.03	0.01
	s	S	S
Sweetlime	1.0	0.04	0.04
	NS	S	S
Carbonated rinks	0.04	0.37	0.001
	S	NS	S

increased. p values of the comparison between different immersion regimes are depicted in Table 3.

Intergroup Comparison: When Low, medium and high immersion regimes of the three groups were compared with each other, the result was statistically significant showing higher microleakage in carbonated drinks and sweet lime as compared to tea group.

Intragroup comparison: On intragroup comparison in tea group, significant difference was found in between low, medium and high immersion periods. On intragroup comparison in sweetlime group, significant difference was found in between low and medium with high immersion periods. On intragroup comparison in carbonated drinks group, significant difference was found in between low & medium and low & high immersion periods. p values of the comparison between different immersion regimes are depicted in Table 5.

Intergroup comparison: When low immersion regimes of the three groups compared with each other, sweetlime group showed significantly higher microleakage scores as compared to carbonated & tea groups. When medium immersion regimes of the three groups compared with each other, carbonated drinks showed significantly higher mean microleakage scores as compared to tea & sweetlime groups. When high immersion regimes of the three groups compared with each other, there was no significant difference in microleakage scores between three experimental groups.

DISCUSSION

Adhesion to the walls of the prepared tooth is an important property for any restorative material to prevent micro leakage. This bond should not be affected by environmental changes and functional stresses in the oral environment, in order to prevent the development of secondary caries and further deterioration of tooth structure. So while considering a material for restoration, marginal integrity is an important concern. In this study to evaluate microleakage, methylene blue dye was used. The diameter of dye molecules is 0.80nm that is less than the diameter of dentinal tubules (1-4μm) (Bayne, 1998). Thermal changes were simulated as that observed in the oral cavity by thermocycling. It is an in-vitro process of subjecting a tooth and restoration to temperature extremes that conform to those found in the oral cavity (Thomazatti, 2002). Commonly consumed soft drinks and fruit juices cause damage to the teeth due to their low pH and high titratable acidity leading to non-carious cervical tooth loss. The sugars in these drinks are metabolized by plaque microorganism to generate organic acids that bring about demineralization leading to dental caries. In the oral cavity, both dissolution of elements and erosion of the non-soluble components of the restorative materials occur. Numerous factors such as low pH, acidic foods, ionic composition, ionic

strength of saliva, and enzymatic attacks are important parameters which may influence the quality and quantity of the substances released from a restorative material as well as its physical and mechanical properties (van Groeningen, 1986). In group 1- tea for Cention-N significant difference was found between low and high immersion regimes and non significant difference was found in medium and high, low and medium immersion regime. In G-aenial universal flo significant difference was found in low, medium and high immersion regime. Tea as it has pH of 5.04 which is much above the critical Ph which is 4 show less microleakage in low, medium and high immersion regime in Cention N and G-aenial Universal Flo which is similar with the study conducted by Dinakaran S (Dinakaran, 2015). In group II- fresh fruit juice (sweet lime) In Cention-N significant difference was found between low and medium, low and high immersion regime whereas non significant difference was found in medium and high immersion regimes. In G-aenial universal flo significant difference was found between low and high,medium and high immersion regime . Whereas non significant difference was found in low and medium immersion regime.

Sweetlime has pH of 2.48 as repeated intake of fresh fruit juice leads to a marked reduction in the salivary pH. In the present study this pH is just below the critical pH of 4 needed to cause enamel erosion and micro leakage of restorative materials. Our findings are in accordance with the study conducted by *Edwards et al* that showed the repeated intake of lime juice produces more micro leakage due to its acidic pH (Edwards, 1999). In group III-carbonated drinks (coca cola), In both immersion regimes significant difference was found between low and medium, low and high immersion regime and non significant difference was found in medium and high immersion regime. The microleakage score increased with increase in frequency of immersion for both Cention-N and G-aenial universal flo (Maganur, 2010). For higher microleakage in Cola drinks was that cola have an inherent acidity due to the presence of both orthophosphoric acid and carbonic acid and Ph of 2.57 as (Steffen, 1996). It is proven that the chemical in Cola soft drinks (group IV) affected the integrity of the enamel surface. It is quite probable that the higher microleakage scores seen in the present study could be due to much of the restorative materials and seleant being removed along with the enamel wall by the high immersion Cola regimes. Our results are similar with the study conducted by Steffen (Wongkhantee, 2006). Therefore, the acidic nature of the cola drink would have affected the integrity of the restoration/enamel which tends to increase enamel demineralization, erosion and the microleakage around the restoration.

To compare the ability of the test beverages to cause marginal leakage, the subgroups within a test group was compared to the corresponding subgroup in the other groups. For example, specimens under low immersion in Group I were compared with specimens under low immersion in Group II and Group III respectively.The generalized result observed during this comparison was that Group III (carbonated drinks) showed higher microleakage than Group II (Fresh fruit juice), followed by Group I (tea), for Cention N and G-aenial Universal Flo . In simpler terms, carbonated drinks caused highest microleakage followed by fresh fruit juice than tea. However the result was not statistically significant. To compare between the two material i.e. Cention-N and G-aenial Universal Flo under different immersion regimes.In our study, in control group, both the material showed similary microleakage score.When we compare under different immersion regime in test beverages, G-aenial Universal Flo exhibited more microleakage than Cention-N. However the result was not statistically significant. In the present study two restorative materials were used in which Cention N sustain less dissolution than G-aenial Universal Flo it may be due to the presence of special patented filler (Isofiller) which acts as a shrinkage stress reliever minimising the shrinkage force. Due to the sole use of cross-linking methacrylate monomers in combination with a stable, efficient self-cure initiator, Cention N exhibits a high polymer network density and degree of polymerization over the complete depth of the restoration .It also includes a special patented filler (Isofiller) which acts as a shrinkage stress reliever minimising the shrinkage force. The organic/inorganic ratio as well as the monomer composition of the material is also responsible for the low volumetric shrinkage leading to least microleakage.

Conclusion

The three beverages used in the study affected the microleakage of both restorative materials significantly. Within the limitation of this in vitro study following conclusions can be drawn

- The microleakage scores increased as the frequency of the immersions increased.
- Carbonated drink caused highest microleakage followed by fresh fruit juice and tea. However the comparison was not statistically significant.
- G-aenial universal flo exhibited more microleakage than Cention-N
- in all groups, however the comparison was not statistically significant.

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