



Research Article

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Comparative evaluation of sorption and solubility of Amalgomer CR and Cention N restorative material- An *in vitro* study

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Abstract

Introduction: The potential of direct restorative dental materials to resist masticatory force, without getting damaged and to remain unaffected after getting exposed to various media (chemical stability) in the mouth for a considerable period of time are important for their good clinical performance. Amalgomer CR is a ceramic reinforced posterior GIC having compressive, flexural and tensile strength close to that of amalgam. Cention N is a new material based on "alkasite" technology which is a subgroup of the composite resin. It is a novel bulk fill direct posterior restorative material. Every restorative material should meet the required ideal physical properties standards, among which water sorption and solubility are two important properties that influences the clinical durability of a restorative material. Chemical agents found in soft drinks and other beverages like coffee and tea can be exposed to restorative materials, continuously or intermittently. The modern dietary habit of frequent consumption of low pH carbonated drinks can alter the oral environment to an acidic range. Keeping all the above discussed factors in mind, this, *in-vitro* study was conducted to compare and evaluate the sorption and solubility of Cention N and Amalgomer CR in four direct solutions; Sprite, Pepsi, Coca Cola and artificial saliva. **Aim:** The aim and objective of this *in-vitro* study was to evaluate the sorption and solubility of Cention N and Amalgomer CR in four direct solutions; Sprite, Pepsi, Coca Cola and artificial saliva. **Materials and methods:** The materials that was used for this study are Cention N and Amalgomer CR. A total of forty samples of restorative material were prepared using a metallic mould and divided into two groups of twenty samples each (n=20); Group I: Cention N and Group II: Amalgomer CR. The weight before immersion in the test media (m1) was measured using digital analytical scale. Each group was subdivided into four subgroups (n=5) based on the test media they were immersed in; Subgroup 1: artificial saliva, Subgroup 2: Coco Cola, Subgroup 3: Pepsi, Subgroup 4: Sprite. Five specimens each of the test material were kept immersed in the test media for seven days. The weight of the samples after immersion (m2) in the test media after seven days and the final dry weight of the samples (m3) were measured. Sorption and solubility of Cention N and Amalgomer CR cement were calculated using ISO guidelines. Data was analyzed statistically using appropriate statistical tools. **Results:** In our study, both Amalgomer CR & Cention N showed values for sorption and solubility well under the values of ISO recommendations, however, Amalgomer CR had significantly more sorption and solubility when compared to Cention N. Among the test solutions used Sprite and Pepsi had the most degrading effect on Cention N and Amalgomer CR. **Conclusion:** The composition of material along with their setting / curing method and low pH carbonated drinks can influence the properties of direct esthetic restorative materials. In this present study, Cention N was marginally better when compared to Amalgomer CR.

Keywords: Cention N, Amalgomer CR, Sorption, Solubility, Alkasite.

INTRODUCTION

The potential of direct restorative dental materials to resist masticatory force, without getting damaged and to remain unaffected after getting exposed to various media (chemical stability) in the mouth for a considerable period of time are important for their good clinical performance [1,2].

Glass ionomer cements (GIC) are cements, which in presence of water, sets by acid based reaction, are one the most commonly used cements around the world. These materials are capable of forming chemical bonding with enamel and dentin, are anticariogenic, biocompatible and have coefficient of thermal expansion close that of tooth structures [3]. Incorporation of ceramics into GIC is one of the more recent development made so as to produce a material with mechanical strength approximating that of amalgam, which was widely used for posterior restoration in the last century. Amalgomer CR, is one such product [4].

Amalgomer CR, in addition to having mechanical strength approximating that of amalgam, is free of shrinkage has excellent wear resistance, and has superior radio opacity.

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It also has good fluoride release, good working time, chemically bonds to tooth structure, along with its superb aesthetics [5].

Cention N is a novel bulk fill direct posterior restorative material based on "alkasite" technology (a subgroup of the composite resin). Advantages of Cention N include bulk placement, optimal physical/mechanical properties, superior esthetics and optional light-curing. 5, 6 When it comes to various important physical properties of a restorative material, water sorption and solubility are important physical properties, which cannot be neglected that influence the clinical durability and success of a restoration. When the material comes in contact with the water, water sorption takes place which will lead to an increase of its volume. This can act as a plasticizer ultimately leading deterioration of the matrix structure of the material, resulting in its failure [6].

Erosive chemical agents found in soft drinks and other beverages like coffee and tea can be exposed to restorative materials, continuously or intermittently [5,6]. The pH of oral cavity varies from acidic to alkaline depending on the foods consumed as well as the salivary changes in each individual. The modern dietary habit of frequent consumption of low pH carbonated drinks can alter the oral environment to an acidic range [7].

Keeping all the above discussed factors in mind, this, in-vitro study was conducted to compare and evaluate the sorption and solubility of Cention N and Amalomer CR in four direct solutions; Sprite, Pepsi, Coca Cola and artificial saliva.

MATERIALS AND METHODOLOGY

The materials used in this study are Cention N (Ivoclar vivadent) and Amalomer CR (Advanced HealthCare LTD, UK). Twenty disc shaped specimens of each restorative material to be tested, measuring 15 ± 0.1mm in diameter and 2mm thickness were prepared in a stainless steel split mould. Products were handled following the manufacturer's instructions. All the forty samples were cleaned and transferred to a desiccator maintained at 37°C with silica gel for 24 hrs. They were stored

in a desiccator at 23°C for 1hr, then weighed to an accuracy of 0.1mg in a digital analytic balance. The cycle was repeated till a mass of loss not more than 0.1mg in any twenty four hour period is achieved. This is the sample weight before immersion (M1).

Two measurements of diameter was taken at right angles to each other using dial caliper and mean diameter was calculated. Area was calculated in millimeter² from the mean diameter and volume was calculated in millimeter³. Five samples of both testing material was kept completely submerged in 10ml of each testing media. The temperature was maintained at 37°C and testing material was kept in testing media for seven days. The test media was grouped as Subgroup 1: Artificial saliva, Subgroup 2: Coco Cola, Subgroup 3: Pepsi, Subgroup 4: Sprite. The test media was replaced, every twenty four hours. The specimens were removed, washed in distilled water and using tissue paper, the surface adherent water was gently blotted away, after a waiting period of 7 days. The samples were waved in air for fifteen seconds and weighed in the balance (M2). This was followed by reconditioning the specimens to constant weight in the desiccator using the earlier cycle.

The sample weight after immersion and dessication (M3) was recorded. The solvent uptake and solubility were determined in µg/mm³ using the Oysaed and Ruyter formula which is, Sorption = (M2 – M3) ÷ V and Solubility= (M1 - M3) ÷ V, Where, M1 = Testing weight before immersion, M2 = testing material weight after immersion, M3 = testing material weight after immersion and desiccation and V is for Volume.

RESULTS

The data obtained was statistically analyzed using one way ANOVA. Any P values was considered statistically significant which was less than 0.05. According to the test results, Amalomer CR showed highest sorption and solubility values when compared to Cention N which was statistically significant. Among the test solutions used, Sprite and Pepsi had the most degrading effect on Cention N and Amalomer CR. These results are summarized in table 1 and 2 and are presented graphically in figure 1 and 2.

Table 1: Sorption

Subgroup	Group	N	Mean	Std. Deviation	p-Value
Artificial saliva	Cention N	5	4.8280	0.5225706	0.78(NS)
	Amalomer CR	5	5.0850	0.5296758	
Coco cola	Cention N	5	24.3316	0.5845753	0.002*
	Amalomer CR	5	29.8944	0.2494971	
Pepsi	Cention N	5	25.7886	0.3427861	0.000*
	Amalomer CR	5	31.9206	0.6993621	
Sprite	Cention N	5	30.0510	0.6095322	0.001*
	Amalomer CR	5	34.4824	0.5338031	

Table 2: Solubility

Subgroup	Group	N	Mean	Std. Deviation	p-Value
Artificial saliva	Cention N	5	2.6728	0.5848284	0.98(NS)
	Amalomer CR	5	3.1360	0.2366749	
Coco cola	Cention N	5	3.5576	0.5636420	0.003*
	Amalomer CR	5	5.5342	0.4368600	
Pepsi	Cention N	5	5.7716	0.6611938	0.000*
	Amalomer CR	5	6.4894	0.4418589	
Sprite	Cention N	5	6.1802	0.4585681	0.001*
	Amalomer CR	5	7.3630	0.3866167	

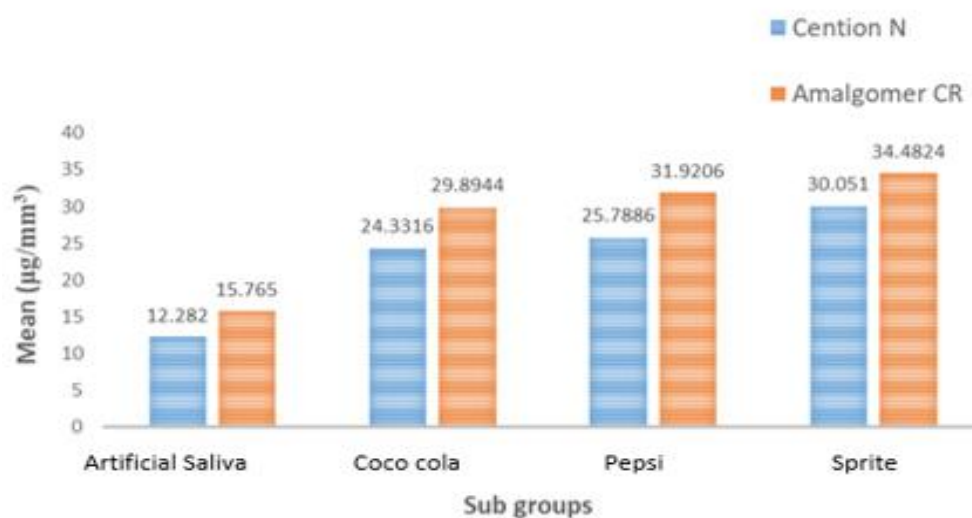


Figure 1: Sorption

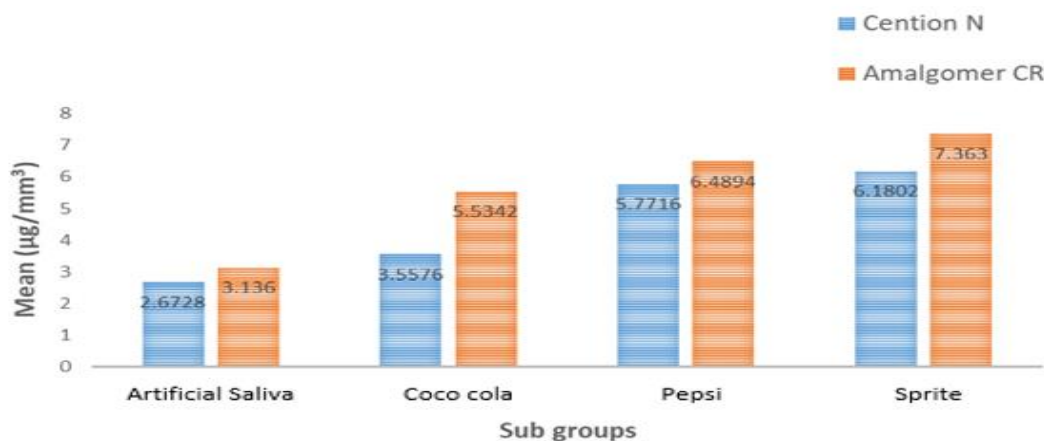


Figure 2: Solubility

DISCUSSION

A good restorative dental material should have good wear resistance and chemical stability towards exposure of various media in the oral environment even after exposure for a considerable period of time, for their good clinical performance. Many experiments are going on in rapid pace in the field of esthetic restorative materials which requires very conservative tooth preparation has led to many recent advancements in posterior esthetic restorative materials. There is requirements for clinical and laboratory researches on these recent materials which play an important role in their selection and patients preferences for these materials [1,2,8].

Among the various important physical properties of dental restorative materials, water sorption and solubility are of considerable clinical importance. Erosive chemical agents found in soft drinks and other beverages like coffee and tea can be exposed to restorative materials, continuously or intermittently [5,6].

Depending on the foods consumed along with the salivary changes of each individual, the pH of oral cavity which might vary from acidic to alkaline. The modern dietary habit of frequent consumption of low pH carbonated drinks can alter the oral environment to an acidic range.7 There are experiments and data which showed that after one single sip of acidic beverages, it will take one to three minutes for the oral fluids to return to neutral pH from acidic pH. However there will negative

affect on teeth or restoration if there is prolonged frequent consumption of carbonated drinks [9].

ISO 4049: 2009 guidelines was referred to conduct the present study. The maximum acceptable solubility value for restorative material is 7.5 µg/mm³ and the maximum acceptable sorption value is 40 µg/mm³ according to the ISO guidelines specification [10]. In the present study, the values of water sorption and solubility for Cention N and Amalgomer CR in all the test media are within the range of the ISO standard.

Cention N is classified as an “alkasite” restorative material, which just like compomer or ormocer is considered to be a subgroup of the composite restorative material. What makes it different and unique is that it contains special patented filler named as Isofiller whose main function is to act as a reliever of shrinkage stress [8].

In the current study, Cention N showed comparatively least sorption and solubility values where the difference was statistically significant when compared to Amalgomer CR. This can be explained with two reasons. One being that Cention N is a dual cured material and there are studies which prove that the dual cured material are more hydrophobic when compared to that of self-cured material. The second reason is that Cention N contains UDMA which is hydrophobic than hydrophilic Bis-GMA, HEMA or TEGDMA which are not present in Cention N. Urethane Dimethacrylate (UDMA) which create rigid networks and absorbs less water and releases higher unreacted monomer due to their hydrophobic nature, could be second reason for the lower solubility and sorption of Cention N in our study [9].

Wilson and Kent introduced Glass ionomer in 1972 which sets by acid base reaction and has a drawback of using as a restorative material in stress-bearing areas [11]. Amalgomer CR is a recently introduced direct esthetic posterior GIC which is said to have strength comparable to that of amalgam due to addition of ceramic particles [4]. Amalgomer CR contains zirconia fillers which makes up 17% by weight having average particle size of 0.8 µm and still bonds to tooth structure chemically [11].

In our study, Amalgomer CR showed comparatively more sorption and solubility values where the difference was statistically significant when compared to Cention N. This can be explained by two reasons. First of the two reasons is that, water based Glass-ionomer cements basically consist of ion-leachable glass and water-soluble polymeric acids which when mixed, in water presence, sets by undergoing acid-base reaction, where water plays an important role. Having said that, all the conventional and other modified glass-ionomer cements still has pores and cracks in their set cement, through which water diffusion happens by surface wash off which may explains the reason for more sorption and solubility of Amalgomer CR [12].

The other reason could be the coarse ceramic particles which are present in powder, which causes microporosities due to poor bonding to their matrix and thus making the material to undergo more water sorption and solubility with time [11].

Coca cola drink was one of test media used and it has pH of 3.1 and has carbonic acid and phosphoric acid present in it. This may be the reason for sorption and solubility of the tested restorative material by it. All the test media used are carbonated drinks having low pH and having different sugary constituents. When materials are exposed to these acidic beverages, the material would provide less barrier for water molecules to enter the polymer network, which significantly increase water sorption of the materials. Similarly all the carbonated drinks with different sugary constituents having low pH could have altered the materials absorption rate more than that of artificial saliva [9].

The restorative materials are in continuous contact with saliva in the oral cavity whose major constitute is water. Saliva has pH range of 6.2 to 7.6. Organic acids present in the saliva can lead of dissolution of the dental

cements. Artificial saliva has pH value of 7 and it was used in this study to simulate the setting similar to oral environment. Study conducted on dental cements with study medium having pH 7 has found that they are more stable [10]. This explains the reason for the least solubility and sorption values of both Cention N and Amalgomer CR test materials in artificial saliva used in our study.

CONCLUSION

With the limitations of this invitro study, we can conclude that the composition of material and low pH observed in the carbonated drinks can affect the physical properties like sorption and solubility of direct esthetic restorative materials. We should also take into consideration of different setting/ curing methods of restorative materials along with patient’s dietary habits for the longevity of restoration.

However, it has to be taken into note that we cannot generalise the study since the study was conducted only for a period of seven days and the restorative materials are not exposed continuously to these immersion media. So further in-vivo studies with longer observation period has to be conducted to know the effect of these solutions on the restorative materials.

Conflicts of Interest

The authors declare no conflict of interest.

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