Comparative Evaluation of Cention with Glass Ionomer Cement, Composite Resins and Silver Amalgam with Respect to Mechanical Strength: An in-Vitro Study

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Abstract

Introduction: Numerous direct filling materials are available to the modern dental practice from amalgams, GIC to modern bulk fill composites. Cention is an **"alkasite"** restorative. Alkasite refers to a new category of filling material, which like compomer or ormocer materials is essentially a subgroup of the composite material class. This new category utilizes an alkaline filler, capable of releasing acid-neutralizing ions. It is a tooth-colored, basic filling material for direct restorations. It is self-curing with optional additional light-curing. It is radiopaque, and releases fluoride, calcium and hydroxide ions. As a dual-cured material it can be used as a full volume (bulk) replacement material. Hence the Aim of the study was to compare the Alkasite (Cention N) with Silver amalgam, GIC and Composite to evaluate the Compressive strength & diametral tensile strength.

Materials and Method: Split molds of dimension 6 [height] x4 [diameter] was used to fabricate 15 samples of each material for testing the compressive strength and for tensile strength. And subjected under Universal Instron testing machine connected to a load measuring cell, to recorded load applied to the samples at a crosshead speed of 0.75 ± 0.25 mm/min till the samples fracture.

Results: Composite and Cention N showed significantly higher strength than Silver Amalgam and Glass ionomer cement.

Conclusion: Within the limitation of this study, it can be concluded that Cention N can be used as a superior alternative when compared with Silver Amalgam and Glass ionomer cement.

Keywords: *Compressive strength, Diametral tensile strength, Restorative materials.*

Introduction

Numerous direct filling materials are available to the modern dental practice – from amalgams through to modern bulk fill composites. Amalgam materials were first introduced to western dentistry in the 19th century[1], glass ionomer cements (GICs) were introduced around the 1970s, composites became standard during the 1980s, resin modified glass ionomers[2] and compomers[3] were introduced in the 1990s and the current decade saw the launch of several bulk-fill composites.

Dental amalgam is sufficiently strong to support moderate biting forces within the first hour[4]. The clinical success of an amalgam restoration depends on various factors including: appropriate cavity preparation involving undercuts due to the non-retentive nature of amalgam, condensation technique, anatomical characteristics and final finish. Although the use of amalgam became popular in the west in the 19th century, its long history and popularity however have not shielded it from controversy[5].

Glass ionomers were invented in the late 60s, first described by Alan Wilson and Brian Kent in the

early 1970s and introduced to the market soon after[6]. Despite their reasonable clinical performance in terms of retention, glass ionomers are usually far less esthetic than composite restoratives[7]. Glass ionomer cements offer depot ion-release and undoubtedly improve on the esthetics of amalgams but they provide far less strength and longevity. Both products clearly have certain drawbacks and represent a clinical compromise in one respect or another.

The advent of new composite restorative materials, together with new adhesives has brought enormous benefits - notably in terms of esthetics and strides towards minimally invasive dentistry. They may however be perceived as expensive, time-consuming and technique-sensitive. Their existence has not eliminated the need for or appropriateness of traditional "basic" dental materials.

Cention N is an **"alkasite"** restorative. Alkasite refers to a new category of filling material, which like compomer or ormocer materials is essentially a subgroup of the composite material class. This new category utilizes an alkaline filler, capable of releasing acid-neutralizing ions[8].

Cention N is a tooth-coloured, basic filling material for direct restorations. It is self-curing with optional additional light-curing. It is radiopaque, and releases fluoride, calcium and hydroxide ions. As a dual-cured material it can be used as a full volume (bulk) replacement material.

Cention N consists of a separately packaged powder and liquid that are mixed by hand directly before use[8]. As a new category of filling material, it is essential to understand its mechanical properties with respect to the common existing permanent restorative materials. Therefore, in this study, it was decided to compare the diametral tensile strength of alkasite (Centrion N) with Glass ionomer cement, composite resin and silver amalgam.

Aim and Objectives

To evaluate and compare the diametral tensile strength of Cention, GIC, Composite and amalgam.

Materials and Method

Materials used were Cention N, Fuji Type IX Glass ionomer cement, 3M ESPE Z 350 XT Composite resin and Dentsply Dispersalloy Silver Amalgam.

Diametral Tensile Strength Test:

Six specimens of 6.0 mm in diameter and 3.0 mm in height were prepared for each material. All the samples were made according to ADA specification number 27. The environmental temperature was controlled and the materials were prepared as per the manufacturer's instructions except Composites. After mixing, the materials were put into into brass moulds, which were slightly over-filled with the materials. A piece of film was placed onto the material in the mould and covered with a glass slide. Hand pressure was then applied for 20 seconds while excess material was extruded from the top of the mould. Two minutes after the placement into the moulds, the assembly was placed in an oven at 37 ± 1 °C and 95 ± 5% relative humidity, for 15 minutes. Then, the specimens were ejected from the mould and stored in 6 mL of deionized water at 37 ± 1 °C. The diametral tensile strength was measured by placing disc shaped specimens of 6mm diameter and 3mm thickness on the lower platform of universal testing machine [Model:3366, Instron] and were loaded at a rate of 0.5mm/min until fracture. The DTS was calculated by dividing the highest load recorded during the test divided by area of the specimen and is reported in MPa [n=6]. Data were subjected to one-way analysis of variance (ANOVA) and a Post HocTukey test for multiple comparisons (<0.001).

Results

Table 1: DTS of Individual of material

		N	Mean	Std. Deviation	Statistics/ mean squares	df2(welch) / F(Anova)	p value
Maximum Compressive stress (MPa)	CENTION	6	51.83167	6.424657	66.669	10.069	<0.001
	GIC	6	15.93333	2.948625			
	COMPOSITE	6	65.90667	12.39706			
	SILVER AMALGAM	6	23.23167	2.025433			
	Total	24	39.22583	21.92236			

Table 2: Inter group Comparison of material tested

Dependent Variable	COMPARISON GROUP	COMPARED WITH	MEAN DIFFERENCE	Std. Error	P VALUE
Maximum Compressive stress (MPa)	CENTION	GIC	35.8983333*	4.16093	<0.001
		COMPOSITE	-14.0750000*	4.16093	0.014
		SILVER AMALGAM	28.6000000*	4.16093	<0.001
	GIC	COMPOSITE	-49.9733333*	4.16093	<0.001
		SILVER AMALGAM	-7.2983333	4.16093	0.324
	COMPOSITE	SILVER AMALGAM	42.6750000*	4.16093	<0.001

Comparison of Maximum Compressive stress (MPa) using one way ANOVA test shows that the mean value of Composite (65.906667) is highest followed by Cention (51.831667), Silver Amalgam (23.231667) least in GIC (15.933333). This difference is statistically Significant with a test value of 10.069 and p value of <0.001. Post hoc Tukey test shows that the difference between Cention and GIC is Statistically significant with a mean difference of 35.8983333* and p value of <0.001. The difference between Cention and Composite is Statistically significant with a mean difference of -14.0750000* and p value of 0.014. The difference between Cention and Silver Amalgam is Statistically significant with a mean difference of 28.6000000* and p value of <0.001. The difference between GIC and Composite is Statistically significant with a mean difference of -49.9733333* and p value of <0.001. The difference between GIC and Silver Amalgam is not statistically significant with a mean difference of -7.2983333 and p value of 0.324. The difference between Composite and Silver Amalgam is Statistically significant with a mean difference of 42.6750000* and p value of <0.001.

Discussion

Among all the restorative materials available, composite resin (Z350XT 3M ESPE) has become the material of choice for restoration of all teeth. The recognition of resin-based composite restoration has increased because of its excellent aesthetic and other favourable characteristics.

In the present study, comparing the results obtained, the null hypothesis was rejected as there was a significant difference in mechanical properties (DTS) among the newer posterior restorative material tested. The restorative materials used in the oral environment are subjected to various occlusal forces. In this study, the mechanical properties of various dental restorative materials were compared and studied. The analysis of DTS is important for the comparison of mechanical properties of dental materials which reflect which material is better to perform clinically and is resistant to the masticatory forces. The result of the study indicated that the four materials tested in the study differed statistically in terms of DTS with a p value of 0.001, which suggests a significant difference in mechanical properties. The findings of this work have shown that the nanofilled composite (Z350XT 3M ESPE) has relatively high DTS (65.90 MPa). Basically, the diametral tensile strength (DTS) is a property described by ADA/ANSI Specification 27 for characterizing dental restoratives. Diametral tensile was also high in Cention N (51.83MPa) as compared with the other tested materials. Composite (Z350XT 3M ESPE) and Cention N showed a statistically significant difference DTS with GIC (Fuji IX) and Silver amalgam with the p value significant at 0.001. The value of diametral tensile strength in Silver amalgam and GIC was 23.23 MPa and 15.93 MPa, respectively. The weakest mechanical properties were obtained by GIC (Fuji IX) with the mean value of 15.93 MPa in DTS. There are various studies with regard to the comparative evaluation of mechanical properties of restorative materials showing contradiction of results. This was in accordance with Kumar et al.[9] and Chalissery et al.[10] who did a comparative study on mechanical properties of direct core build-up materials. They concluded that the composite had high mechanical properties followed by Cention N and GICs showed the weakest; this is in agreement with our study.

Conclusion

In the present study, it can be concluded that the mean compressive strength and DTS values of all the four restorative materials were significantly different because the composite materials available have a variation in composition and viscosity. The nanohybrid composite Z350-XT has the highest DTS and the properties of Cention N were almost similar. Silver Amalgam and GIC (Fuji IX) exhibited the least values when compared with that of the other materials.

Conflict of Interest: NIL

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