

Comparative Evaluation of Flexural Strength of Cention N, Zirconomer And Glass Ionomer Cement Fuji IX : An

In-Vitro Study

Anil K Tomer¹, Megna Bhatt², Leena Tomer³, Afnan Ajaz Raina⁴, Hysum Mushtaq⁵, Supriya Singh⁶, Shivendra Ahlawat⁷.

¹Professor & Head, Department of Conservative Dentistry and Endodontics, Divya Jyoti College of Dental Sciences and Research, Uttar Pradesh

^{2,4,5,6,7} Post Graduate Student, Department of Conservative Dentistry and Endodontics, Divya Jyoti College of Dental Sciences and Research, Uttar Pradesh

³Professor, Department of Prosthodontics, Divya Jyoti College of Dental Sciences and Research, Uttar Pradesh

Corresponding Author: Dr. Megna Bhatt, PG Student, Department of Conservative Dentistry and Endodontics, Divya Jyoti College of Dental Sciences and Research, Modinagar, Ghaziabad, Uttar Pradesh, 201204, India.

Citation this Article: Anil K Tomer, Megna Bhatt, Leena Tomer, Afnan Ajaz Raina, Hysum Mushtaq, Supriya Singh, Shivendra Ahlawat. “Comparative Evaluation of Flexural Strength of Cention N, Zirconomer And Glass Ionomer Cement Fuji IX : An In-Vitro Study”, *ijmsir*- January - 2020, Vol – 5, issue -1, P. No. 01-06.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Cention-N is recently introduced material. So, the aim of this study is to compare the flexural strength of Cention-N, Zirconomer and glass ionomer cement fuji IX. For testing flexural strength, 5 samples of each group will be fabricated using plexi glass molds of size 25×2×2 mm. The samples will be then stored in distilled water at 37°C for 24 hours prior to testing. One-way ANOVA will be used to analyse the data and to evaluate statistical differences among the groups.

Keywords: Flexural strength, Zirconomer, Glass ionomer cement fuji IX.

Introduction

The restoration of lost tooth due to caries, fracture or endodontic treatment offers many challenges for the dentist because of the large percentage of failures which has led to the development of magnitude of restorative alternatives for teeth.

In the oral cavity, restorations undergo stress from masticatory forces producing different reactions that lead to deformation, which can ultimately compromise their durability over time¹.

Amalgam has been using to restore tooth structure since the 19th century. Amalgam also has good longevity and the lowest cost of any of the restorative materials. Among amalgam's significant deficiencies are its susceptibility to constant corrosion, inability to strengthen the teeth, inability to seal teeth initially, and lack of esthetics. Since the 1890s, amalgam – a metallic restorative material obtained by combining mercury and mixture of silver, tin, and copper alloy – was widely chosen for such restorations by dental practitioners because of its high compressive strength and tensile strength, durability, longevity, and marginal integrity of the material; moreover, there was lack of availability and development in the field of restorative

materials. However, due to increase in demand of esthetics, its lack of adhesion to tooth surface, and the potential hazard of mercury toxicity considered by Food and Drug Administration (FDA), the pursuit for alternative materials fulfilling these shortcomings began¹.

The **glass ionomer cement** is the most widely used core-build up material. It was introduced by Wilson and Kent in 1971 and has undergone innumerable changes and inclusions in its properties and composition to overcome its inherent drawbacks such as lack of strength, early moisture sensitivity and inadequate esthetics².

The use of Zirconia is from 1980. A new material known as **Zirconomer** (Zirconia + GIC) reinforced with ceramic and zirconia fillers is introduced. It is also known as white amalgam. It defines a new class of restorative glass ionomer that promises the strength and durability of amalgam with the protective benefits of glass ionomer while completely eliminating the hazard of mercury¹. It is capable of releasing fluoride, thus having anti-cariogenic property.

The glass component of Zirconomer is subjected to controlled micronization, to acquire optimum particle size and characteristics. The grain size has an effect on an exclusive characteristic of zirconia called transformation toughening, which gives it higher strength, toughness, high hardness, and corrosion resistance; thus, when it is homogeneously incorporated in the glass component, it further reinforces the material for lasting durability and high tolerance to occlusal load¹.

In quest of better properties, recently, **Cention N** has been introduced in dentistry in 2017 which the manufacturers claim to possess best of the properties of Amalgam and GIC. 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. The alkaline glass of Cention N releases hydroxide ions, creating conditions whereby excess acidity due to cariogenic bacterial activity can be neutralized.

Cention N exhibits a high polymer network density and degree of polymerization over the complete depth of the restoration. This is a good basis for long lasting restorations⁵.

The comparison of flexural strength would help the clinician to choose the appropriate and best core material available for the restoration of weakened tooth structure³.

Materials and Method

The samples made with Cention N and Zirconomer will comprise the experimental group while the samples made with Glass ionomer cement (Fuji IX) will comprise the control group[Table 1].

Group	Test done	Material used	Brand name	Number of samples
IF	Flexural Strength	Glass ionomer fuji IX	G C America	5
ZF	Flexural Strength	Zirconomer	Shofu	5
CF	Flexural Strength	Cention N	Ivoclar Vivadent	5

For flexural strength evaluation as per ISO 4049 specifications, rectangular plexi glass split molds of dimension 25 ± 1 mm{length}x 2 ± 1 mm{height}x 2 ± 1 mm{width} will be used for fabricating samples of each material⁵. [Fig 1]

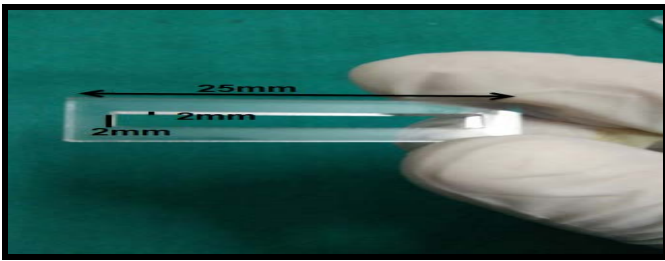


Fig 1: Rectangular plexi glass mold

A total of 15 samples (Fig 2) were fabricated with 5 samples of each material namely glass ionomer cement fuji IX [GC America] (Fig. 2a), Zirconomer [Shofu] (Fig. 2b) and Cention N (Fig 2c) to test the flexural strength. The samples were stored in water bath at 37 ± 10 C for 24 h before testing. The samples were tested using a Universal Instron testing machine (Fig 3). The universal instron testing machine was connected to a load measuring cell, which continuously recorded the load applied to the samples at a crosshead speed of 0.75 ± 0.25 mm min⁻¹ till the samples fracture.

The fabricated samples were mounted on 3 point bending test device and loaded in Universal Testing Machine at a cross head speed of 1mm/min. The maximum fracture load (F in Newton) of each sample was recorded and flexural strength was calculated .

The flexural strength in Megapascals (MPa) was calculated using the following formula:

$$F.S = 3FL / 2BH^2$$

Where,

- F is the maximum load in newtons, exerted on the specimens.
- L is the distance, in millimeters between the jig supports (20 mm)
- B is the width, in millimeters, of the specimen measured immediately prior to testing.
- H is the height, in millimeters, of the specimen measured immediately prior to testing.

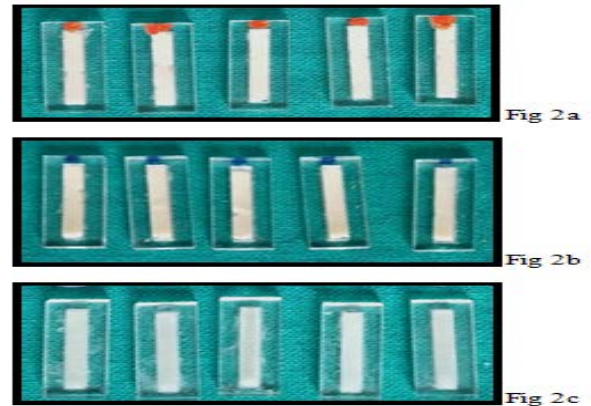


Fig 2: Samples

Result

The values were recorded for flexural strength [MPa] in the three groups IF, ZF, CF which are Glass ionomer Cement Fuji IX [GC America], Zirconomer [Shofu], Cention N [Ivoclar Vivadent] respectively. The observations were then subjected to statistical analysis.[Tables 2]. Comparison of Flexural Strength(MPa) between the three materials (Cention N, Zirconomer and Glass ionomer cement fuji IX) was done. The Null Hypothesis 1 was that there is no significant difference in the mean flexural strength (in MPa) of the 3 materials i.e. $\mu_1 = \mu_2 = \mu_3$. The Alternate Hypothesis was that there is a significant difference in the mean flexural strength (in MPa) of the 3 materials i.e. $\mu_1 \neq \mu_2 \neq \mu_3$. The Level of Significance considered for values to be significant was $\alpha = 0.05$. In order to compare the means of the 3 materials ANOVA analysis was used. The P value was compared with the level of significance. If $P < 0.05$, the alternate hypothesis was accepted and concluded that there is a significant difference in the mean flexural strength of the materials. Otherwise the null hypothesis is accepted. If there is a significant difference between the materials then multiple comparisons (Post—Hoc tests) using Bonferroni test is carried out.



Fig 3: Universal Instron Testing Machine

Higher mean flexural strength was recorded for Cention N [Ivoclar Vivadent] followed by Zirconomer [Shofu] and Glass ionomer cement fuji IX [GC America] respectively. Lowest flexural strength was recorded for Glass ionomer cement fuji IX [GC America]. The difference in mean flexural strength between the different materials was found to be statistically significant ($P < 0.001$). In order to find out among which pair of materials there exists a significant difference, Bonferroni test was done [Table 3,4]. The difference in mean flexural strength between Cention N and the other materials was found to be statistically significant ($P < 0.001$). The difference in mean flexural strength between the groups was also found to be statistically significant ($P < 0.001$) [Fig 4].

Table 2: Comparison Of Flexural Strength Between Three Groups

Groups	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Cention	104.40	8.706	3.893	93.58	115.21	93.00	115.00
Zirconomer	64.20	9.257	4.140	52.70	75.69	50.00	75.00
GIC Fuji	31.80	6.418	2.870	23.83	39.76	22.00	38.00

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	13227.600	2	6613.800	97.886	0.001
Within Groups	810.800	12	67.567		

Table 3: Comparison of Flexural Strength between three groups using ANOVA followed by Bonferroni analysis.

Groups	Groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Cention	Zirconomer	40.200	5.198	0.001	25.75	54.64
	GIC Fuji	72.600	5.198	0.001	58.15	87.04
Zirconomer	Cention	-40.200	5.198	0.001	-54.64	-25.75
	GIC Fuji	32.400	5.198	0.001	17.95	46.84
GIC Fuji	Cention	-72.600	5.198	0.001	-87.04	-58.15
	Zirconomer	-32.400	5.198	0.001	-46.84	-17.95

$p \leq 0.05$ is significant

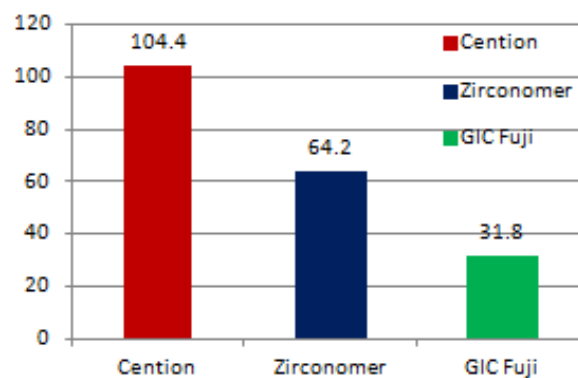


Fig 4

Discussion

Strength is considered to be a critical indicator of success as it helps to resist masticatory and parafunctional forces⁴.

Flexural strength is used to evaluate the strength of the material and the amount of the distortion expected under bending stress. Cention N offers tooth-coloured esthetics together with high flexural strength. The new filling material belongs to the materials group of

Alkasites. The highly cross-linked polymer structure is responsible for the high flexural strength. The initiator system enables good chemical self-curing.

The fillers of Cention N were chosen to achieve strength but also to obtain the desired handling characteristics of the mixed material. All the fillers therefore (except ytterbium trifluoride) are surface-modified to ensure wettability by the liquid and incorporation into the polymer matrix. The inorganic fillers comprise a barium aluminium silicate glass filler, ytterbium trifluoride, an Isofiller (Tetric N-Ceram technology), a calcium barium aluminium fluorosilicate glass filler and a calcium fluorosilicate (alkaline) glass filler. This Isofiller, which is also used in Tetric N-Ceram Bulk Fill, acts as a shrinkage stress reliever which minimizes shrinkage force⁶.

Zirconomer defines a new class of restorative glass ionomer. The inclusion of zirconia fillers in the glass component of Zirconomer reinforces the structural integrity of the restoration and imparts superior mechanical properties for the restoration of posterior load bearing areas where the conventional restorative of choice is amalgam. High flexural modulus and compressive strength ensures longevity in stress bearing areas¹.

Glass Ionomer cements bond chemically to tooth achieved via initial cross linking of Ca ions with polyacrylic acid forming calcium polyacrylate chains. Final setting involves cross linking of trivalent Al ions with polyacrylic acid forming aluminium polyacrylate chains. The Ca and Al polyacrylate cross linked chains become hydrated over time with water being present in the liquid. This process is known as maturation. Thus, the microstructure of set cement consists of agglomerates of unreacted glass particles (glass cores which serves as filler in cement matrix) surrounded by

silica gel embedded in an amorphous matrix of hydrated Ca and Al polysalts. Water plays an important role in setting reaction of GIC by serving initially as reaction medium and then slowly hydrates the matrix. During initial setting, water is loosely bonded to Ca polyacrylate chains and at this stage, any loss of water from exposure to ambient air or uptake of water from moisture contamination results in chalky, cracked surface and leaching of ions from matrix respectively. Both uptake and loss of water results in weak and more soluble cement with reduced translucency. Hence, this is prevented by coating of varnish immediately after placing the restoration².

In the present study the flexural strength of the Cention N and Zirconomer were compared with conventional Glass ionomer fuji IX. Considerable difference was found in the flexural strength among these groups. Cention N which is formulated to be used as a restorative material was significantly stronger than the other materials in terms of flexural strength followed by Zirconomer and Glass ionomer fuji IX.

Conclusion

Under the limitations of the study, Cention-N showed highest flexural strength and least flexural strength was shown by glass ionomer cement Fuji IX. Thus, Cention N and Zirconomer can be used as a potential posterior restorative material of choice.

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