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Original Article

Evaluation and comparison of flexural strength of Cention N with resin-modified glass-ionomer cement and composite – An *in vitro* study

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Abstract

Aim: The aim of this study was to evaluate and compare the flexural strength of Cention N with resin-modified glass-ionomer cement and nanohybrid composite.

Materials and Methods: Samples were prepared by filling the stainless steel mold of dimension 2 mm × 2 mm × 25 mm with cement/composite immediately after mixing. Excess flash if any was removed by abrading it with abrasive paper. Then, the specimens were subjected to flexural strength measurement using universal testing machine. The results were then tabulated and statistically analyzed using one-way ANOVA followed by Tukey's multiple *post hoc* test.

Results: The average flexural strength of NT Premium, Vitremer, and Cention N was 90.39 MPa, 46.59 MPa, and 62.88 MPa, respectively. There was a statistically significant difference between NT Premium and Cention N and NT Premium and Vitremer with $P = 0.0002$ and 0.0001, respectively.

Significance: The flexural strength study can help us to choose a material for restoring Class V lesions and can also confirm whether Cention N, a new material, be a definite replacement for amalgam.

Conclusion: Cention N has proved to be a better material and can be a replacement for amagam and GIC.

Keywords: Cention N; flexural strength; three-point bend test

INTRODUCTION

Dental caries is a major oral health problem, affecting 60%–90% of the population. Cavities affecting the cervical third of buccal and lingual surfaces of all teeth are known as Class V cavities, according to the classification devised by Sir G.V. Black. These lesions can be carious or noncarious. Studies have shown that the development of Class V lesions is multifactorial.[1-3] Hence, such lesions should be critically analyzed for the cause of lesion before planning the restorative treatment. A plethora of materials are available for restoration of Class V lesions such as glass ionomers, composites, amalgam, and compomer.

Conventionally, glass-ionomer cement (GIC) have been used in varied clinical applications. Their ability to bond physicochemically to both enamel and dentin,[4,5] biocompatibility with the dental tissue,[6] fluoride ion release,[7,8] and low thermal expansion coefficient, similar to that of tooth structure, have made it as a material of choice. Despite of these advantages, conventional glass ionomers have low fracture toughness and flexural strength[9,10] and rough surface texture and opaqueness[11] and are susceptible to moisture. Hence, polymerizable glass-ionomer

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materials were developed. These photopolymerizable or resin-modified glass ionomers have the advantages of shorter setting time, reduced early moisture sensitivity, increased working time, and better mechanical properties than those of the conventional GIC.[12,13]

Another material which is commonly used for restoration of Class V lesions is composite resin. Fillers have been added to the traditional composite resins to improve their esthetic and mechanical properties.[14,15] Thus, microfilled composites, hybrid composites, and nanofilled composites were developed.

An innovative filling material "Cention N" is marketed recently offering tooth-colored esthetics with high flexural strength. Manufacturers claim that Cention N is intended for restoring deciduous teeth and for permanent restorations of a Class I, II, or V nature. Unfortunately, whatever the material is the failure rate of Class V restorations is comparatively high and common.[16]

Properties of materials, such as fracture resistance and elasticity under stress, are evaluated by the determination of properties of flexural strength, flexural modulus, and fracture toughness.[17] Furthermore, according to Prosser *et al*., the most appropriate measure of the strength of GIC is obtained with a flexural test.[18]

Hence, in this study, the flexural strength of Cention N will be evaluated and compared with resin-modified GIC and nanohybrid composite.

MATERIALS AND METHODS

The materials used in this study were resin-modified GIC – Vitremer (3M ESPE), composite resin – NT Premium (Coltene), and Cention N (Ivoclar). Samples were prepared by filling the stainless steel mold of dimension 2 mm × 2 mm × 25 mm with cement/composite immediately after mixing ($n = 10$). The mold was covered with a polyester film and glass plate on both sides. The material was then cured using Bluedent LED Smart (BG Light LTD) for 30 s. Excess flash if any was removed by abrading it with abrasive paper. The procedure for the preparation of the Cention N group was the same except that these group specimens were not subjected to light activation. Then, the specimens were subjected to flexural strength measurement using universal testing machine (ACME Engineers, India, Model No. UNITEST-10). The samples were tested at a crosshead speed of 1 mm/min until the specimen fractured. The flexure strength of each specimen was calculated using the formula $3FL/(2BH^2)$

Where F is the maximum load (in N), L: distance between the supports (in mm), B: width of the specimen (in mm), and H: height of the specimen (in mm).

The results were then tabulated and statistically analyzed using one-way ANOVA followed by Tukey's multiple *post hoc* test.

RESULTS

The mean flexure strength of Composite, resin-modified GIC, and Cention N was 90.39 MPa, 46.59 MPa, and 62.89MPa, respectively. One-way ANOVA test showed that there was a significant difference between the groups with $P < 0.0001$. Further, pairwise comparison of these materials using Tukey's multiple *post hoc* procedures revealed a significant difference between NT Premium and Cention N and NT Premium and Vitremer with $P = 0.0002$ and 0.0001, respectively.

DISCUSSION

The newer composite restorative materials have enormous benefits and strides toward minimally invasive dentistry. They may, however, be expensive, time-consuming, and technique sensitive. The need for appropriate traditional "basic" dental materials has not yet eliminated. Hence, amalgam and glass ionomers still remained popular under particular dental circumstances. A real alternative to amalgam or GIC – a cost-effective, fluoride-releasing product – was introduced into market recently by Ivoclar. This material Cention N is quick and easy to use without complicated equipment. According to manufacturer's Cention N has advantages of amalgam and GIC. Hence, in the present study, Cention N was compared with Vitremer (3M ESPE), a resin-modified GIC, and NT Premium (Coltene) for their flexural strength.

Furthermore, in the present study, the different materials used for Class V restoration were evaluated and compared.

Flexural strength is an appropriate mechanical property for brittle materials although the results cannot be similar to the materials' clinical behavior. Brittle dental materials like cement have a tensile strength markedly lower than the compressive strength. As commented by Prosser *et al*., the most appropriate measure of the strength of GIC is obtained with a flexural test.[18] Compressive strength is indirectly related to the shear and tensile failure. Furthermore, measurement of tensile strength by loading in diametral compression is only valid in the absence of significant plastic flow. Hence, in this study, the materials were subjected for the flexural strength.

The study utilized the *in vitro* three-point bending flexural test as recommended by the ISO 4049/20008 specification.[19,20] The three-point bending test was used due to the lower standard deviation, the lower coefficient

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Table 1: Summary of flexural strength (MPa) in three materials

Materials	*n*	Minimum	Maximum	Mean	SD	SE	95% CI for mean	
							Lower bound	Upper bound
Composite	10	61.69	119.06	90.39	20.31	6.42	75.87	104.92
RM GIC	10	33.75	66.00	46.59	11.93	3.77	38.05	55.13
Cention (*n*)	10	46.12	92.62	62.89	14.82	4.69	52.28	73.49

SD: Standard deviation, SE: Standard error, CI: Confidence interval, RM GIC: Resin-modified glass-ionomer cement

Table 2: Comparison of three materials with respect to flexural strength (MPa) by one-way ANOVA test

Sources of variation	df	Sum of squares	Mean square	*F*	*P*
Between groups	2	9802.59	4901.30	18.9860	0.0001*
Within groups	27	6970.28	258.16		
Total	29	16772.87			

*$P<0.05$

of variation when compared to those produced by other test designs, such as the biaxial flexural test.[19]

In the present study, the average flexural strength of NT Premium, Vitremer, and Cention N was 90.39 MPa, 46.59 MPa, and 62.88Mpa, respectively [Table 1]. When statistically analyzed using one-way ANOVA test, there was a significant difference between the groups with $P < 0.0001$ [Table 2]. Further, pairwise comparison of these materials was performed using Tukey's multiple *post hoc* procedures. There was a statistically significant difference between NT Premium and Cention N and NT Premium and Vitremer with $P = 0.0002$ and 0.0001, respectively [Table 3]. The comparison of the materials in their flexural strength is depicted in Figure 1.

The results obtained in this study are in comparison with other studies where composite has higher flexure strength than GIC.[21,22]

Vitremer, a resin-modified GIC, consists of fluoroaluminosilicate glass, micro-encapsulated potassium persulfate, and ascorbic acid which make up the patented redox catalyst system that provides the methacrylate cure of the glass ionomer in the absence of light. The liquid consists of a light-sensitive, aqueous solution of a polycarboxylic acid modified with pendant methacrylate groups. It also contains water, HEMA, and photoinitiators. The specimens were cured from one side, hence the possibility of incomplete conversion of the resin component. This is supported by improvement in strength when the specimens were cured on two opposing surfaces.[23]

NT Premium, a nanohybrid composite, consists of Bis-GMA which is an aromatic ester of a dimethacrylate, synthesized from an epoxy resin and methyl methacrylate; thus, it is rigid yet presents high viscosity.[24] In addition, the matrix consists modified urethane (Bis-EMA) which reduces the polymerization shrinkage and the intrinsic stresses of the

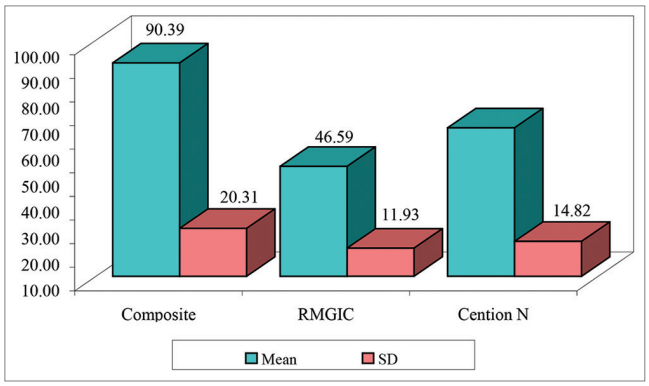

Figure 1: Comparison of three materials with respect to flexural strength (MPa)

material. However, the presence of TEGDMA in composition has been associated to decrease the flexural strength of the material.[25] Although TEGDMA creates a dense and flexible network, the mechanical property of a material is a result from a complex combination of microstructural and compositional factors. Hence, in this study, NT Premium has proved better than the other two materials.

Cention N is an "alkasite" restorative material which, like compomer or ormocer materials, is essentially a subgroup of the composite material class. It consists a combination of UDMA, DCP, an aromatic aliphatic-UDMA, and PEG-400 DMA interconnects (cross-links) during polymerization resulting in strong mechanical properties and good long-term stability. UDMA is the main component of the monomer matrix which exhibits moderate viscosity and yields strong mechanical properties. The inorganic filler barium-aluminum-silicate glass imparts strength to the material.[26] In the present study, light curing of the material was not done.

All the materials used in this study are intended to use for restorations of Class V cavities. As stipulated by ISO standard 4049 for polymer-based restorative materials, the flexural strength for Class II materials has to be a minimum of 50 MPa and 80 MPa for Class I materials.[27]

As mentioned by the ISO Standards, all the materials tested satisfy the standards to greater extent. Cention N and Vitremer have a flexural strength <80 MPA and hence are used in restorations of Class V cavities. NT Premium has higher flexure strength and is intended to be used in Class I restorations.

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Table 3: Pair wise comparison of three materials with respect to flexural strength (MPa) by Tukeys multiple posthoc procedures

Materials	Mean difference	Std. Error	Sig.	95% Confidence Interval	
				Lower bound	Upper bound
Composite					
RMGIC	43.80	7.1855	0.0001*	25.99	61.62
Cention N	27.51	7.1855	0.0020*	9.69	45.32
RMGIC					
Cention N	-16.30	7.1855	0.0780	-34.11	1.52

Hence, within the limitations of the study, all the materials definitely can be used as Class V restorative materials. Further studies need to be done to correlate these materials with clinical conditions.

CONCLUSION

New material Cention N is a material comparable with composite and resin-modified GIC for Class V restorations. Further clinical studies for its longevity need to be carried out to prove as an alternative material for composite and glass ionomers.

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Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Bader JD, McClure F, Scurria MS, Shugars DA, Heymann HO. Case-control study of non-carious cervical lesions. Community Dent Oral Epidemiol 1996;24:286-91.
2. Pintado MR, Delong R, Ko CC, Sakaguchi RL, Douglas WH. Correlation of non-carious cervical lesion size and occlusal wear in a single adult over a 14-year time span. J Prosthet Dent 2000;84:436-43.
3. Khan F, Young WG, Shahabi S, Daley TJ. Dental cervical lesions associated with occlusal erosion and attrition. Aust Dent J 1999;44:176-86.
4. Mount GJ. Clinical placement of modern glass-ionomer cements. Quintessence Int 1993;24:99-107.
5. Hotz P, McLean JW, Sced I, Wilson AD. The bonding of glass ionomer cements to metal and tooth substrates. Br Dent J 1977;142:41-7.
6. Mason PN, Ferrari M. *In vivo* evaluation of glass-ionomer cement adhesion to dentin. Quintessence Int 1994;25:499-504.
7. Swartz ML, Phillips RW, Clark HE. Long-term F release from glass ionomer cements. J Dent Res 1984;63:158-60.
8. Walls AW. Glass polyalkenoate (glass-ionomer) cements: A review. J Dent 1986;14:231-46.
9. McCabe JF, Jones PA, Wilson HJ. Some properties of a glass ionomer cement. Br Dent J 1979;146:279-81.
10. Goldman M. Fracture properties of composite and glass ionomer dental restorative materials. J Biomed Mater Res 1985;19:771-83.
11. Crim GA. Marginal leakage of visible light-cured glass ionomer restorative materials. J Prosthet Dent 1993;69:561-3.
12. Rusz JE, Antonucci JM, Eichmiller F, Anderson MH. Adhesive properties of modified glass-ionomer cements. Dent Mater 1992;8:31-6.
13. Croll TP. Light-hardened class I glass ionomer – Resin cement restoration of a permanent molar. Quintessence Int 1993;25:109-13.
14. Ilie N, Hickel R. Resin composite restorative materials. Aust Dent J 2011;56 Suppl 1:59-66.
15. Göhring TN, Gallo L, Lüthy H. Effect of water storage, thermocycling, the incorporation and site of placement of glass-fibers on the flexural strength of veneering composite. Dent Mater 2005;21:761-72.
16. Perez CR. Alternative technique for class V resin composite restorations with minimum finishing/polishing procedures. Oper Dent 2010;35:375-9.
17. Manhart J, Kunzelmann KH, Chen HY, Hickel R. Mechanical properties and wear behavior of light-cured packable composite resins. Dent Mater 2000;16:33-40.
18. Prosser HJ, Powis DR, Wilson AD. Glass-ionomer cements of improved flexural strength. J Dent Res 1986;65:146-8.
19. Chung SM, Yap AU, Chandra SP, Lim CT. Flexural strength of dental composite restoratives: Comparison of biaxial and three-point bending test. J Biomed Mater Res B Appl Biomater 2004;71:278-83.
20. Palin WM, Fleming GJ, Marquis PM. The reliability of standardized flexure strength testing procedures for a light-activated resin-based composite. Dent Mater 2005;21:911-9.
21. Piwowarczyk A, Ottl P, Lauer HC, Büchler A. Laboratory strength of glass ionomer cement, compomers, and resin composites. J Prosthodont 2002;11:86-91.
22. Jayanthi N, Vinod V. Comparative evaluation of compressive strength and flexural strength of conventional core materials with nanohybrid composite resin core material an *in vitro* study. J Indian Prosthodont Soc 2013;13:281-9.
23. Kanchanavasita W, Anstice HM, Pearson GJ. Long-term flexural strengths of resin-modified glass-ionomer cements. Biomaterials 1998;19:1703-13.
24. Della Bona A, Benetti P, Borba M, Cecchetti D. Flexural and diametral tensile strength of composite resins. Braz Oral Res 2008;22:84-9.
25. Rodrigues Junior SA, Zanchi CH, Carvalho RV, Demarco FF. Flexural strength and modulus of elasticity of different types of resin-based composites. Braz Oral Res 2007;21:16-21.
26. Cention N Scientific Documentation. Available from: http://www.ivoclarvivadent.in/en-in/p/all/cention-n. [Last accessed on 2021 Nov 30].
27. International Organization for standarization. Resin-based dental filling Materials (Class B).1SO 4049, 988.