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An In-Vitro Evaluation of Shear Bond Strength of Cention N and Glass Ionomer Cement

Dr. Richa Goel, Prof & HOD, Department of Public Health Dentistry, Karnavati School of Dentistry, Karnavati University, Gandhinagar, Gujarat

Dr. Arunkumar Sajjanar, Professor and Head, Department of Pediatrics and Preventive Dentistry, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur

Dr. Vani Singh, Senior Lecturer, Department of Public health Dentistry, Bhabha College of Dental Sciences, Bhopal, Madhya Pradesh.

Dr. Prasad Chandrakant Ingale, Assistant Professor, Department of Conservative and Endodontics, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Sangli, Maharashtra

Dr. K. Shiva Charan Yadav, MDS, Periodontist, Malak Al Rahma Polyclinic, Riyadh, Saudi Arabia.

Dr. Gajji Renuka, MDS, Orthodontist, Malak Al Rahma Polyclinic, Riyadh, Saudi Arabia

Corresponding author: Dr Richa Goel, Prof & HOD, Department of Public Health Dentistry, Karnavati School of Dentistry, Karnavati University, Gandhinagar Gujarat. Email id: drrichagoel@gmail.com

Abstract

Background: The glass ionomer cements developed by Wilson and Kent have several advantages such as fluoride release, adhesion to mineralized dental tissues and a coefficient of thermal expansion similar to that of tooth structure. In spite of so many favorable properties, its poor mechanical properties, limited indication range and low esthetic value led to the further development of resin-based composites. Cention N is an “alkasite” restorative material which like compomer or ormocer is essentially a subgroup of the composite material class. This new category utilizes an alkaline filler, capable of releasing acid-neutralizing ions.

Aim: In order to select the best restorative material to restore carious tooth, this study compared the shear bond strengths of cention N and traditional glass ionomer cement.

Material and Method: A total of 30 samples of GIC Type II and Centon N were examined to determine the shear bond strength. In a universal testing machine with a crosshead speed of 1 mm/min, sample cylinders with dimensions of 4 mm in diameter and 4 mm in height were bonded to the buccal surface of teeth to assess the shear bond strength. The data collected were tabulated accordingly and were subjected to statistical analysis using Statistical Package for the Social Sciences -version-22-(IBM SPSS Statistics.)

Result: The values for shear bond strength of Cention N were statistically highly significant ($P < 0.001$) as compared to GIC Type II.

Conclusion: Cention N presented with high shear bond strength and can be a good alternative to conventional glass ionomer cement.

Keywords: Cention N, Glass Ionomer Cement, Shear Bond Strength

Introduction: Dentin and tooth enamel were affected by dental caries. A tooth with decay has poor form and performance. It can be repaired and restored by the restorative substance if attended early.[1,2] Restoring the biologic, functional, and aesthetic qualities of healthy tooth structure is what a restorative material does. The modern dentistry practise has access to a wide range of direct filling materials, including bulk fill composites and modern amalgams.[3] Numerous aspects are crucial for a restorative material's durability. Strength is one of the crucial factors.[4] A restorative material should have sufficient compressive and shear bond strength to withstand long-term multidirectional masticatory stresses.[5]

Since the beginning of dental practise, dentists have faced this issue as well, and a significant portion of dental science is still devoted to finding artificial materials that may replace missing tooth structure.[6] For many years, dental amalgam has been the preferred restorative material. The safety of dental amalgam has, however, been under increased scrutiny recently, mostly due to concerns about potential mercury toxicity.[7] Dental experts have developed alternative restorative materials in response to the rising demand for aesthetics. It is crucial to preserve tooth structure in the modern era of adhesive dentistry.[8,9]

The modern dental practitioner has access to a wide range of direct filling materials for posterior load-bearing restorations, from silver amalgam to glass ionomer cement, contemporary bulk-fill composites. The glass ionomer cements developed by Wilson and Kent have several advantages such as fluoride release, adhesion to mineralized dental tissues and a coefficient of thermal expansion similar to that of tooth structure. In spite of so many favorable properties, its poor mechanical properties, limited indication range (unsuitable for stress bearing situations) and low esthetic value led to the further development of resin-based composites. Patients' ability to withstand stress, durability, the integrity of the marginal sealing, aesthetics, and turnaround time are among the main considerations when choosing a restorative material. Due to the significant occlusal load, mechanical and physical characteristics are crucial in posterior tooth restorations.[1] The invention of light-cured composites marked a significant advancement in direct restorative. Composites were first made available in the 1960s and have been around for almost to 50 years.[11] Although composite resin materials have strong physical qualities, the main drawbacks include postoperative sensitivity, secondary cavities, and polymerization shrinkage leading to marginal microleakage.[12]

Cention N, a basic filling material that is tooth-colored and used for direct restorations, has recently become more significant in restorative dentistry. It has an additional light-curing option and is self-curing. By integrating bulk placement, ion release, and durability in a dual-curing, aesthetic solution, the alkasite Cention N redefines the standard filling and meets the needs of both patients and dentists. It has been claimed that Cention N possesses strength similar to amalgam and the aesthetics of GIC.[13]

The resistance to forces that push restorative material past tooth structure is known as the "shear bond strength." Because the main dislodging pressures at the tooth restoration contact have a shearing impact, it takes significant clinical significance for the restorative material. Higher shear bond strength hence indicates better material to tooth bonding.[15,16] Hence the

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present study aim to evaluate shear bond strength of conventional glass ionomer cement and Cention-N.

Material and Method:

The materials used in this study were:

1. Conventional Glass Ionomer Cement (Fuji II GIC, GC, Tokyo, Japan)
2. Cention-N (Ivoclar Vivadent)

Collection of Samples: The following 30 premolar teeth with healthy buccal or lingual surfaces that needed to be extracted for orthodontic therapy were gathered. However, teeth that had caries on both the buccal and lingual surfaces, where the crown of the tooth had broken during extraction, or that had any form of developmental defect were discarded. There was debris removal, ultrasonic scaling, and autoclaving of the teeth. The Occupational Safety and Health Administration (OSHA) recommended that all of the chosen teeth be used within three months of collection.

Preparation of Samples: Using a diamond-disk with water cooling, the crowns of the collected teeth were removed from the roots at the cemento-enamel junction (CEJ), which is perpendicular to the tooth's long axis. **(Fig 1)** The teeth were then submerged in self-curing acrylic resin to create a testing platform, aligning the buccal surfaces with the acrylic resin block surface. To ensure that the dentin of every sample reached the same depth, a 1.5 mm deep groove was created from the enamel surface using a fissure diamond bur.

Fig 1: Sample Preparation

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Specimen Grouping: Cylinders of the samples measuring 4 cm diameter and 4 mm height were prepared. Initially, molds using modeling wax were prepared with the measured dimensions. After this, the molds were filled with the restorative material by mixing the powder and liquid according to the manufacturer's instructions.

In Group I the dentinal surface in this group was conditioned for 20 seconds with a solution of 10% polyacrylic acid (Dentin conditioner; GC International). Next, the surface was washed with water spray for a few seconds, and blotted with sponge taking care not to dessicate the dentin. After this, a plastic matrix formed was placed perpendicular to the conditioned dentinal surface. Then the powder and the liquid component of Fuji II was mixed and loaded into the plastic matrix using a plastic instrument. After setting of the cement, the plastic matrix was removed. The molds were filled up to the height of the cylindrical mold, and the sample was covered with mylar strip, followed by covering with glass slab. The samples were then de-molded, and finishing was done using finishing burs.

Similarly in group II Etching and bonding of cavity surfaces were done for 20 and 10s, respectively. Subsequently, Cention N (Ivoclar Vivadent) cement was mixed according to manufacturer's instructions (powder: liquid 4.6:1 part by weight) and placed into the cavity using a plastic filling instrument and light-cured with a visible light curing unit for 20 s and then immediately finished and polished using burs.

Storage of Samples: The samples stored in deionized water at 37Cº in an incubator for 7 days, then thermocycled for 60 cycles between 5±1Cº and 55±1Cº with a dwell time of 30 seconds.[17]

Evaluation of Shear Bond Strength: Shear bond strength of each sample was measured using a universal testing. A shear load was applied to the glass ionomer/Cention N interface with a knife-edged rod of 0.5 mm width at a crosshead speed of 0.5mm/min (6, 11, 12). The bond strength at failure was calculated as the recorded failure load divided by the surface area of the bonded surface and expressed in Megapascal.

Data were collected and statistically evaluated. Chi square test were used to analyze the data with $p < 0.05$ set as level of significance.

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Result: Cention-N (7.04 ± 0.59 MPa) showed higher shear bond strength as compared to conventional glass ionomer (3.67 ± 0.54) cement which was found to be statistically significant ($p \leq 0.001$).

Table 1: Mean Value of Shear Bond Strength	
Group	**Mean Value of Shear Bond Strength**
Group I Conventional GlC	3.67 ± 0.54 MPa
Group II Cention-N	7.04 ± 0.59 MPa
P value	$p \leq 0.001$

Discussion: Glass ionomers and amalgam, which have both been used economically and traditionally as filling materials, continue to be preferred in specific dental situations. Contemporary dental practises have access to a wide range of direct filling materials, including bulk-fill composites and contemporary amalgams.[18,19]

In the 19th century, amalgam materials were first used in dentistry in the West. Although amalgams have unmatched durability and strength, they also have a bad aesthetic and questionable components. But choosing a restorative material is no longer primarily based on how long the restoration would last. When choosing a restorative material, aesthetics are equally important. Additionally, low intervention dentistry has replaced conventional dentistry in the tooth preparation process. Dental amalgam has become less popular as a restorative material as a result of the rising rate of avoidance due to its mercury content and the excessive replacement of functional amalgam restorations.[14,20]

As a "powder-liquid filling material," Cention N (IvoclarVivadent, Liechtenstein) is a new form of glass incorporating posterior, direct filling, tooth-colored restorative material. It is an alkasite urethane dimethacrylate restorative substance that uses an alkaline filler and emits ions that neutralise acids.[10] According to theory, the presence of isofiller with a low modulus of elasticity functions as a stress reliever for shrinkage, hence minimising microleakage and polymerization shrinkage. Because it has alkaline glass fillers, it can release fluorides, calcium, and hydroxide ions, all of which are advantageous, especially in a cariogenic environment.[21,22] Due to its dual curing properties, this material can be utilised for bulk placement with or without adhesives. According to the literature, applying adhesive improves Cention N's sealing capacity.[23]

In order to withstand numerous dislodging forces operating within the oral cavity, the clinical success of restorative material depends on a strong adhesion with dentinal surface. Because the main dislodging pressures at the tooth restoration interface have a shearing effect, shear bond strength is crucial for the restorative material clinically. Higher shear bond strength hence indicates better material to tooth bonding. The findings of this investigation indicate that Cention N's shear bond strength was significantly greater than GIC Type II's.[18]

Result of our study in accordance to the study conducted by Verma V et al. (2020)[13], Kumari A et al. (2022)[22], Pathak AK et al. (2021)[24], Balagopal S et al. (2021)[25].

The existence of a stable self-cure initiator and a strongly cross-linked polymer structure in Cention N may be the cause of its increased bond strength. Additionally, barium aluminium silicate and calcium aluminium silicate glass filler particles give the Cention N strength, making it a more suitable and durable material in the stress-bearing posterior region.[26]

Because of their flaws, conventional glass ionomers do poorly in the SBS tests, which causes them to cohesively fail in these circumstances. Conventional GICs, on the other hand, have additional advantageous characteristics including little setting shrinkage, high flexibility, and the capacity to demonstrate self-repair mechanisms if cracks start to emerge in them. All of these elements contribute to the longevity of restorations in the oral environment.[15]

Thus, we may conclude that Cention N® is a basic filler material with good mechanical and aesthetic features that can be employed in a variety of restorative treatments in routine clinical practice.

Conclusion: Due to its superior mechanical qualities when compared to GICs, Cention N®, an alkasite filling material, can be a good alternative. It is used as permanent restorative material in posterior teeth.

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Conflict of interest: None

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