Comparative Evaluation of Shear Bond Strength of Glass Ionomer Cement, Composite and Cention-N in Primary Molars: An In-Vitro Study

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Abstract:

Aim: The aim of this study was to evaluate and compare the shear bond strength of Glass Ionomer Cement (Fuji IX GP), Composite Resin (Filtek Z-250) and Cention N (Ivoclar Vivadent).

Material and Method: Sample size taken for the study was 30 deciduous molars with intact buccal or lingual surfaces. Samples were randomly divided and restored into three groups, i.e., groups A Glass Ionomer Cement (Fuji IX GP), group B Composite Resin (Filtek Z-250), and group C Cention N (Ivoclar Vivadent). Thermocycling was done to simulate oral conditions. After 24 hours, shear bond strength was determined using Universal testing Machine at crosshead speed of 0.5 mm/ minute until fracture. Results were tabulated and statistically analyzed.

Result: Glass ionomer cement (Fuji IX GP) showed the lowest mean shear bond strength 3.43 ± 0.67 and the composite resin (Filtek Z 250) showed the highest mean shear bond strength 16.32 ± 0.75 MPa while the mean shear bond strength of Cention-N was 7.34 ± 0.73 MPa.

Conclusion: It was concluded that composite restorative materials show higher shear bond strength than glass ionomer cement and Cention-N in primary molars, but shear bond strength of cention-N was higher than that of glass ionomer cement.

Keywords: Primary teeth, Cention-N, Shear Bond Strength

Introduction: In order to preserve the health of the craniofacial complex, teeth, and gums, as well as the tissues that surround the mouth on the face and head, oral health is a crucial component of overall health.[1] Human teeth can only regenerate to a certain extent.[2]

Dental caries is a long-term condition that affects teeth and causes demineralization of the enamel and dentin due to organic acids created by bacterial fermentation of carbohydrates. It is a complex illness that is mostly influenced by dietary choices, plaque buildup, and host characteristics such tooth surface, saliva, and pellicle.[3]

Previously, the treatment of dental caries was based on the idea that it was a progressive condition that, if left untreated, would eventually result in tooth loss.[4] As a result, the management of dental caries in the modern period comprises determining a person's risk for the growth of the disease as well as monitoring disease progression and providing the necessary preventative services, as well as restorative therapy when necessary. In contrast, some carious lesions might not spread and hence not require repair.[5]

Due to its excellent mechanical qualities, silver amalgam has been a preferred dental restorative material for the repair of posterior teeth for more than 100 years. Yet, one of the longest and most persistent debates in medicine is on the safety of mercury and any potential links to a number of ailments.[6] The modern dental practitioner has access to a wide range of direct filling materials for posterior load-bearing restorations, from silver amalgam to contemporary bulk-fill composites. The main considerations for a restorative material for paediatric patients include their resilience to stress, durability, integrity of the marginal sealing, aesthetics, and turnaround time for the repair. As it is subjected to a significant amount of occlusal force, mechanical and physical qualities are crucial in posterior tooth restorations. With the introduction of light-cured composites, direct restorative technology advanced. Since its introduction in the 1960s, composites have been readily available. Although composite resin materials have strong physical qualities, their principal drawbacks are secondary caries, postoperative sensitivity, and polymerization shrinkage that results in marginal microleakage.[7]

Since its introduction by Wilson and Kent, glass ionomer cement (GIC) has been popular in paediatric dentistry due to its biocompatibility, anticariogenic properties due to fluoride release, and usage in non-traumatic restorative techniques.[8] Furthermore, it chemically adheres to the enamel and dentin, obviating the necessity for a retentive cavity preparation and making the material effective for both minimally invasive and maximum tooth structure preservation.[9,10] However, certain drawbacks, including susceptibility to moisture during the early setting period, limited working time, prolonged setting and maturation time, low fracture toughness, and reduced wear resistance, have restricted their usage to locations that experience masticatory stress.[11]

A basic filling material for direct restorations that is tooth-colored and popularised recently is called Cention N. It has an optional extra light cure and is self-curing. Hence, the alkasite Cention N redefines the conventional filling by fusing bulk placement, ion release, and durability in a dual-curing, aesthetically pleasing solution. This meets the needs of both patients and dentists. According to certain theories, Cention N can be as strong as amalgam and look as good as GIC.

The purpose of this study was to evaluate and compare the shear bond strength of Glass Ionomer Cement (Fuji IX GP), Composite Resin (Filtek Z-250) and Cention N (Ivoclar Vivadent).

Material and Method: The outpatient clinic, Department of Pedodontics and Preventive Dentistry, employed 30 extracted human maxillary and mandibular primary molars for present in-vitro study.

Inclusion criteria for teeth

- Caries free sound tooth
- Teeth extracted due to pre shedding mobility
- Teeth with intact buccal and lingual surface

Exclusion criteria for teeth

- Carious tooth
- Tooth with developmental anomaly

The teeth were carefully cleaned after extraction and then preserved in thymol. These teeth were then cleaned with pumice and kept in normal saline. To establish a platform for testing, the teeth were then immersed in self-curing acrylic resin so that the buccal surfaces were parallel to the acrylic resin block surface. A fissure diamond bur was used to make a 1.5 mm-deep groove from the enamel surface to help each sample's dentin reach the same depth. Samples were randomly divided into 3 groups.

Group I Glass Ionomer Cement (Fuji IX GP): 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 (2 mm high, internal diameter of 3mm) was placed perpendicular to the conditioned dentinal surface. Then the powder and the liquid component of Fuji IX was mixed and loaded into the plastic matrix using a plastic instrument. After setting of the cement, the plastic matrix was removed.

Group II Composite Resin (Filtek Z-250): Teeth restored with Filtek Z 250 (Composite Resin) The dentinal surface in this group was etched for 15 seconds with Total Etch gel (Ivoclar-Vivadent). The surface was then rinsed with water, and blotted with sponge. The bonding agent was applied and cured for 10 seconds, followed by placing of Filtek Z-250 into the plastic matrix and cured for 20 seconds. After the curing, the plastic matrix was removed.

Group III Cention N (Ivoclar Vivadent): The prepared cavity was rinsed thoroughly with air/ water spray and dried. Etching and bonding of cavity surfaces were done for 20 and 10s, respectively. Subsequently, Cention N (IvoclarVivadent) 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.

The samples from all three groups were kept in room-temperature normal saline for a full day. All groups' shear bond strengths were evaluated using a universal testing machine. A rod in the shape of a chisel was positioned close to the bonded restorative material and directly next to the flat dentinal surface. To debond the material, a cross head of universal testing machine at a speed of 0.5mm/min was employed (Fig 1). Then, Mega Pascal Units (MPa) were used to calculate the shear bond strength.

Fig 1: Universal Testing Machine

Result: Glass ionomer cement (Fuji IX GP) showed the lowest mean shear bond strength 3.43 ± 0.67 and the composite resin (Filtek Z 250) showed the highest mean shear bond strength 16.32 ± 0.75 MPa while the mean shear bond strength of Cention-N was 7.34 ± 0.73 MPa.

Table no 1: Mean shear bonding strength

Group	Mean ± SD	P Value	Significant groups at 5% level
GIC (*n*=10)	3.43 ± 0.67 MPa	< 0.05	III Vs I
Composite (*n*=10)	16.32 ± 0.75 MPa		III Vs II
Cention-N (*n*=10)	7.34 ± 0.73 MPa		II Vs I

Discussion: The effectiveness of bonding restoration materials to dentin is assessed using bond strength measurements. When compared to an intact tooth, a repaired tooth conducts stress differently. Any force acting on the restoration will cause it to compress, tensile, or shear along the tooth restoration interface, which will result in a complicated stress distribution that combines compressive, tensile, and shear stresses.

The true nature of the material's adhesive strength at the contact is revealed by the shear bond strength since mastication is one of the indentation processes and is essentially analogous to the shearing phenomenon.[13] Shear bond strength is influenced by the type of bond (micromechanical, ion exchanging), as well as the type of restorative materials. (Robert et al, 2001).[14]

The ideal restorative material should have favorable marginal adaption, biocompatibility, chemical adhesion, and a comparable thermal expansion coefficient to the tooth. Dentin adhesion is a beneficial property to prevent pulpal damage, microleakage, secondary caries, and marginal discoloration.[15]

The most popular restorative material for primary teeth employed in the current investigation was glass ionomer cement. They stick to wet dental structure and base metals, and because fluoride is released, they have anticariogenic characteristics. They are biocompatible, have low cytotoxicity, and have a low coefficient of thermal expansion that is comparable to those of tooth structure, making them thermally compatible with tooth enamel.[16]

The adverse effect on the physical and mechanical properties of the earlier type of auto-cure glass ionomer arising from premature exposure to water, or following prolonged dehydration, has been well documented. Immersion in an aqueous environment leads to water absorption and erosion, and dehydration causes crack formation. Both problems adversely affect the strength, as well as the translucency, leading to loss of esthetics in the restoration.[17]

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 material that uses an alkaline filler and emits ions that neutralize acids.[18] According to theory, the presence of isofiller with a low modulus of elasticity functions as a stress reliever for shrinkage, hence minimizing 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 pediatric environment.[18,19] Due to its dualcuring properties, this material can be utilized for bulk placement with or without adhesives.[20]

The clinical success of restorative materials hinges on their ability to adhere well to the dentinal surface and withstand the different stresses that can dislodge them from the oral cavity. Clinically speaking, shear bond strength is crucial for the restorative material since the main dislodging forces at the tooth restoration contact have a shearing impact. Therefore, greater shear bond strength indicates better material to tooth bonding.[6] The findings of this investigation indicate that the shear bond strength of Centon N was significantly greater than that of GIC Type IX but lesser then that of composite resin. Manuja et al. hypothesized that GIC Type IX had the lowest shear bond strength values which is in accordance to our study.[21]

The higher results for Cention N may be explained by the fact that a resin-based restorative's reactive component is made up of monomers as well as initiators, catalysts, and other additives. Due to the interaction (cross-linking) that occurs during polymerization, the mixture of UDMA, DCP, an aromatic aliphatic-UDMA, and PEG-400 DMA results in excellent mechanical capabilities and good long-term stability. The major element of the monomer matrix is UDMA. It has a strong mechanical composition and a moderate viscosity. The great flexural strength is a result of the strongly cross-linked polymer structure.[12]

Conclusion: The results of the present study indicate significantly higher shear bonding strength values for composite, Cention N as compared to GIC Type IX, thus recommending its use as a restorative material for pediatric dental patients. Further, in vivo studies are, however, required to authenticate it as an ideal restorative material.

Limitation of study: The current research has the obvious drawback of not accurately imitating the environmental conditions of the oral cavity because it was conducted in vitro. In addition, samples or substances that fail cohesively produce results that do not accurately reflect the strength of the link itself but rather the flaws in the sample or substance. So, it is important to design testing processes so that only adhesive fracture occurs.

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