SVOA Dentistry

ISSN:2753-9172

ScienceVolks Open Access

Research

Comparative Evaluation of Shear Bond Strength of Glass Ionomer Cement, Composite and Compomer in Primary Teeth: An In Vitro Study

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DOI: https://doi.org/10.58624/SVOADE.2023.04.0127

***Received:** March 29, 2023* ***Published:** April 11, 2023*

Abstract

Background: Because the main dislodging pressures at the tooth restoration interface have a shearing effect, shear bond strength is crucial for the restorative material clinically. Therefore, greater shear bond strength suggests improved material to tooth bonding. Glass ionomer cement and composite is the most popularly used restorative material. Composite resins have better mechanical properties and esthetics than many other types of cement, but they need bonding agents as they are hydrophobic and hence fail to adhere to the teeth. Compomers are polyacid modified resin composites. Compomer and composite resin have similar physical properties, as they are thought to bond to dentin by micromechanical bonding. As resin composites are used in this, the polymerized acid monomer shows acidity when it comes in contact with the saliva and there is a reaction of fluoride-containing basic glass resulting in the cariostatic effect.

Aim: 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 Compomer, (Compoglass, Ivoclar).

Material and Method: An in-vitro, experimental study was conducted on 30 freshly extracted over-retained deciduous molars. Samples were randomly divided into three groups depending on the material to be used. Flat dentinal surface on tooth was prepared over which restorative materials were placed. The prepared specimen was subjected to shear test and the value obtained was compared. Descriptive statistical analysis was performed to calculate the mean shear bond strength of each group.

Result: It was observed from the study that the composite resin had the highest shear bond strength value (17.13 ± 1.54), followed by compomer (11.32 ± 1.05) whereas GIC showed the least shear bond strength (6.56 ± 0.87).

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

***Keywords:** Shear bond strength, Compomer, GIC, Primary teeth*

Introduction

Restoring body parts that have been lost due to an accident or illness has long been a challenge for medical practitioners. Dental practitioners have also been confronted Since the beginning of dental practice, people have struggled with this issue, and a bigger portion of dental science is still devoted to finding artificial materials that can replace missing tooth structure.[1]

Oral health is a critical aspect of general health since it helps to maintain the wellbeing of the craniofacial complex, teeth apparatus, as well as the orofacial tissues that surround the mouth on the face and head.[2, 3]

Dentin and enamel demineralize as a result of dental caries, a chronic disorder that affects teeth and is brought on by organic acids produced by bacterial fermentation of carbohydrates. It is a complex sickness that is mostly influenced by dietary decisions, plaque accumulation, and host characteristics like tooth surface, saliva, and pellicle.[4]

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.[5] 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.[6]

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.[7] 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 pediatric 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.[8]

Glass ionomer cement (GIC) has gained popularity in pediatric dentistry since it was first introduced by Wilson and Kent due to its biocompatibility, anticariogenic characteristics from fluoride release, and use in non-traumatic restorative procedures.[9] 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.[10,11] 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.[12]

Compomers have become available more recently and are recommended for use as a pediatric restorative material. Compomers are a cross between composite resin and glass ionomer cement and are officially termed polyacid-modified, resin-based composites. The fluoride release from compomers is less than that of glass ionomer cements. The mechanical properties of tensile and flexural strength as well as wear resistance of compomers are superior to that of glass ionomers.[13,14]

The aim of this study was to assess and compare the shear bond strength of Glass Ionomer Cement (Fuji IX GP), Composite Resin (Filtek Z-250) and Compomer, (Compoglass, Ivoclar).

Material and Method

30 primary molar teeth from children between the ages of 7 and 10 that still had their crown structures intact were used in the current in-vitro investigation. The chosen teeth had either undergone orthodontic extractions or had exfoliated because of pre-shedding movement. Teeth with fractured crown, any kind of developmental anomaly or caries were excluded to avoid related structural changes occurring in dentin due to these factors. Selected teeth were cleaned with a hand scaling instrument. Teeth with any visible structural defects, internal resorption, cracks or carious lesions. The teeth were then stored at room temperature in distilled water until use. The teeth were sectioned mesiodistally into buccal and lingual surfaces. A groove of 1.5 mm depth from the enamel surface was created using a fissure diamond bur to assist in reaching a uniform depth of dentin in all samples. The specimens were randomly assigned to 3 groups of 10 teeth each. Each group (n= 10) was restored as group A with Glass Ionomer Cement (Fuji IX GP), group B with Composite Resin (Filtek Z-250) and group C Compomer, (Compoglass, Ivoclar). Shear bond strength of all groups were measured using a Universal testing machine. A chisel shaped rod was aligned, immediately adjacent to the flat dentinal surface in close proximity to the bonded restorative material. A cross head speed of 0.5mm/min was used to debond the material. The shear bond strength was then calculated in Mega Pascal Units (MPa). Results were statistically evaluated using multiple range Turkey's HSD type test, and One Way ANOVA was used to calculate the p-value.

Result

It was observed from the study that the composite resin had the highest shear bond strength value (17.13 ± 1.54), followed by compomer (11.32 ± 1.05) whereas GIC showed the least shear bond strength (6.56 ± 0.87).

Group	Mean ± SD	P Value	Significant groups at 5% level
GIC (*n*=10)	6.56 ± 0.87	< 0.05	III Vs I
Composite (*n*=10)	17.13 ± 1.54		III Vs II
Compomer (*n*=10)	11.32 ± 1.05		II Vs I

Discussion

The dental disease known as dental caries in the current study is an infectious microbiologic condition that affects the teeth and results in localized calcified tissue disintegration and destruction.[14,15] Good marginal adaptation, biocompatibility, chemical adhesion, and a similar thermal expansion coefficient to the tooth are all qualities that a perfect restorative material should possess. In order to avoid secondary caries, microleakage, marginal discoloration, and consequent pulpal damage, dentin adhesion is a useful characteristic.[16]

Shear bond strength of the restorative materials were examined in the current investigation since they are crucial for withstanding mastication stresses. Shear bond strength is the maximum amount of force required to fracture the interface between a bonded restoration and the tooth surface with the failure occurring in or near the adhesive interface.[17]

In the present study, Glass Ionomer cement were used, as being the most commonly used restorative materials for primary tooth. They adhere to moist tooth structure and base metals, have anticariogenic properties due to release of fluoride. They have thermal compatibility with tooth enamel because of low coefficient of thermal expansion similar to those of tooth structure, are biocompatible, and have low cytotoxicity.[12]

Compomers are a pediatric restorative material that has lately become more widely accessible and is advised.[13] Compomer material, is a polyacid modified composite resin containing either or both of the essential components (basic glass and acidic polymer) of a GIC but at levels insufficient to promote the acid base cure reaction in the absence of light.[18,19] After initial light-activated polymerization, the traditional glass-ionomer reaction slowly emerges through the uptake of water, activation of carboxylic groups of the dimethacrylate monomer, and the establishment of an acid-base reaction.[20-22]

Result of our study showed that composite restorative materials show higher shear bond strength than glass ionomer cement and compomer in primary molars, but shear bond strength of compomer was higher than that of glass ionomer cement.

Lowest shear bond strength was observed with glass ionomer cement this could be because they are susceptible to attack by moisture during the initial setting period. They have short working time, long setting, and maturation time. Furthermore, they are susceptible to fracture and exhibit low wear resistance.[23]

Conclusion

Shear bond strength is important to the restorative material clinically because of the fact that the major dislodging forces at the tooth restoration interface have a shearing effect. Therefore, higher shear bond strength implies better bonding of the material to the tooth. It was concluded that composite restorative materials show higher shear bond strength than glass ionomer cement and compomer in primary molars, but shear bond strength of compomer was higher than that of glass ionomer cement. Hence within limitation of the present study composite, Compomer proved to be the material with high adhesiveness to both primary teeth. Therefore, it can be recommended as a suitable restorative material for both primary teeth.

Limitation of study

Being an in vitro study, the current research has the obvious problem of not accurately simulating the environmental conditions of the oral cavity. Additionally, the results from samples or materials that fail cohesively do not reflect the strength of the connection itself but rather the weakness of the sample or substance. Therefore, testing procedures should be set up so that only adhesive fracture happens.

Conflict of Interest

The authors declares no conflict of interest

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Citation: Sharma C, Kaur H, Aggarwal M, Jakhu S. Comparative Evaluation of Shear Bond Strength of Glass Ionomer Cement, Composite and Compomer in Primary Teeth: An In Vitro Study. *SVOA Dentistry* 2023, 4:2, 52-56.