Original Article

Glass Ionomer Cements As Luting Agents

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Abstract

Background: To study and evaluate the glass ionomer cements as luting agents.

Materials & methods: A total of 40 teeth were divided into different groups. Extracted teeth were included in the present study. Each experimental group consisted of 10 embedded teeth. They were classified as zinc phosphate, zinc polucarboxylate, glass ionomer cement and resin-modified glass ionomer. Complete analysis was done using SPSS software.

Results: The glass ionomer cement for compressive strength was 90-250 MPa and tensile strength was 5-7 MPa. The glass ionomer cement showed greater bond strength as compared to others.

Conclusion: The results of this study suggest that glass ionomer cements provide sufficiently high bond strengths.

Keywords: glass ionomer cement, compressive bond strength, capping crown.

Introduction

Multiple factors affect the success of fixed prosthodontic restorations with preparation design, oral hygiene/microflora, mechanical forces, and restorative materials being some of them. However, key factor to success is the choice of a proper luting agent and the cementation procedure. Loss of crown retention was found to be the second leading cause of failure of crowns and fixed partial dentures while a study listed uncemented restorations as the third leading cause of prosthetic replacement with failure occurring after only 5.8 years of service. [1,2]

Glass-ionomer cements belong to the class of materials known as acid-base cements. They are based on the product of reaction of weak polymeric acids with powdered glasses of basic character. [3] Setting occurs in concentrated solutions in water and the final structure contains a substantial amount of unreacted glass which acts as filler to reinforce the set cement. The term "glass-ionomer" was applied to them in the earliest publication, but is not strictly correct. The proper name for them, according to the International Organization for Standardization, ISO, is "glass polyalkenoate cement", but the term "glass-ionomer" (including the hyphen) is recognised as an acceptable trivial name, and is widely used within the dental profession. [4,5] Glass-ionomers have various uses

within dentistry. They are used as full restorative materials, especially in the primary dentition, and also as liners and bases, as fissure sealants and as bonding agents for orthodontic brackets.

Tensile bond strengths of glass-ionomers to untreated enamel and dentine are good. [6] Values on enamel vary between 2.6 to 9.6 MPa and values on dentine vary from 1.1 to 4.1 MPa. Bond strengths are typically higher to enamel than to dentine, which suggests that the bonding takes place to the mineral phase. Bond strengths develop quickly, with about 80% of the final bond strength being achieved in 15 minutes, after which it increases for several days. [7] Hence, this study is conducted for glass ionomer cements as luting agents.

Materials & methods

A total of 40 teeth were divided into different groups. Extracted teeth were included in the present study. Each experimental group consisted of 10 embedded teeth. All resin and glass ionomer cements were mixed and applied in accordance with the manufacturers' instructions. They were classified as zinc phosphate, zinc polucarboxylate, glass ionomer cement and resin-modified glass ionomer. The cement with luting properties was taken as sample of 10 teeth showing luting of capping a crown was considered. The data was collected and evaluated. Results obtained were carefully studied and compared. Complete analysis was done using SPSS software.

Results

Different groups with each of 10 teeth were considered to study. Bond strengths were noted. The compressive bond strengths of zinc phosphate was 70-105 MPa and tensile strength was 4-6 MPa. The compressive strength for zinc polycarboxylate cement was 50-90 MPa. The glass ionomer cement for compressive strength was 90-250 MPa and tensile strength was 5-7 MPa. The glass ionomer cement showed greater bond strength as compared to others.

Table 1: bond strengths in cements

Cements	Strengths (MPa) Compressive	 Tensile
Zinc phosphate	70-105	4-6
Zinc polycarboxylate	50-90	6-10
Glass ionomer cement	90-250	5-7
Resin-modified glass ionomer	80-130	10-20

Discussion

In 1969, a new translucent cement was developed by Wilson and Kent [8] based on acid–base reaction between aluminosilicate glass powder and an aqueous solution of polymers and copolymers of acrylic acid, including itaconic,maleic, and tricarboxylic acid. This cement was given the genetic name Glass-ionomer cement (GIC) and the trivial name was ASPA (Aluminosilicate polyacrylate). [9] Glass-ionomer cement has been defined by McLean, Nicholson and Wilson as the "cement that consists of a basic glass and an acidic polymer which sets by an acid–base reaction between these components" . [10] The word 'Ionomer' was coined by the Dupont company to describe its range of polymers containing a small proportion of ionized or ionizable groups, generally of the order of 5–10%. [11] Hence, this study is conducted for glass ionomer cements as luting agents.

In present study, different groups with each of 10 teeth were considered to study. Bond strengths were noted. The compressive bond strengths of zinc phosphate was 70-105 MPa and tensile strength was 4-6 MPa. A study by Reynolds IR et al, assessed GC Fuji Ortho as an orthodontic bonding agent under different enamel conditions and evaluate the shear bond strength. Stainless steel contour bracket with bondable mesh measured about 3.42 mm in length and 3.31 mm in width. Group 1 bonded with GC Fuji Ortho after getting etched with 37% phosphoric acid/60 seconds. Group 2 was contaminated with saliva. Group 3 was conditioned with Fuji dentin condition. Group 4 unetched, uncontaminated, and Group 5 was treated with rely bond composite resin after getting etched

with 37% phosphoric acid. The shear bond strength was tested using Instron universal testing machine. The force at which bond failed was recorded on XY recorder as shear/peel bond strength of the material used for bonding. The reading obtained were statistically analyzed. Rely bond showed highest bond strength of 64.70 N (Newtons). The next highest value was that of Group 1. The lowest bond strength in the Group 4. [(11)] In our study, the mean shear bond strength for fuji ortho LC dry conditioned and GC fuji ortho dry unconditioned at 24 hour was 14.60 and 4.18, at 7 days was 12.58 and 3.01. The shear bond strength for glass ionomer cement in capping material was 6.01. [12]

In the present study, the compressive strength for zinc polycarboxylate cement was 50-90 MPa. The glass ionomer cement for compressive strength was 90-250 MPa and tensile strength was 5-7 MPa. The glass ionomer cement showed greater bond strength as compared to others. Another study by Coups- Smith KS et al, was done to show (1) assess the shear bond strengths of resin-reinforced glass ionomer Fuji Ortho LC and GC Fuji Ortho cements under differing conditions and (2) compare their bonding performance with that of conventional resin composite bonding systems. A sample of 264 bovine incisors was divided into 22 groups of 12 teeth each and bonded with SPEED central incisor brackets. A self-cure composite resin (Phase II) and a light-cure composite resin (Transbond XT) served as controls and were etched with 37% phosphoric acid and bonded in a dry field. They showed that no significant difference existed between the glass ionomer cements under wet or dry conditions, provided the enamel was conditioned with 10% polyacrylic acid before bonding. Both glass ionomer cements were thus acceptable for bonding. Transbond XT had the highest mean shear bond strength irrespective of the incubation period. A positive correlation was obtained between the ARI scores and bond strength. [13]

However, with the use of GIC as a luting agent, frequent postcementation sensitivity has been reported. The then accepted ANSI/ADA Specification 41, Recommended Standard Practices for Biological Evaluation of Dental Materials stipulated that luting agents should be tested for pulp reaction in primates by passively inserting a heavier than luting consistency mix in Class V restorations in primates. Indeed the results of these tests demonstrated that the cement was biocompatible and nonirritating. [14] In a subsequent study, also in primates, crowns were cemented adhering to a clinically more relevant cementation protocol, with a cement mix that had a normal luting consistency. [15]

Conclusion

The results of this study suggest that glass ionomer cements provide sufficiently high compressive bond strength.

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