Glass ionomer cements as luting agents for orthodontic brackets

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Abstract

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

Materials & methods: A total of 50 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 to the brackets and enamel in accordance with the manufacturers' instructions. They were classified as according to material transbond XT, GC fuji ortho LC and GC fuji ortho. Teeth were given conditions accordingly as dry, wet also the surface treated was conditioned or unconditioned.

Results: The results showed that wet unconditioned surfaces consistently produced higher shear bond strengths than dry unconditioned surfaces. Wet or dry conditioned surfaces, however, produced higher shear bond strengths than unconditioned wet or dry surfaces. 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.

Conclusion: The results of this study suggest that glass ionomer cements provide sufficiently high shear bond strengths to retain orthodontic brackets under clinical conditions.

Keywords: glass ionomer cement, shear bond strength, orthodontic brackets.

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Introduction

Adhesive interfaces influence greatly clinical success of modern dentistry. Durability of the interface can be determined by using several in vitro testing methods. Shear bond strength tests are widely used in dentistry and they are well suitable for testing orthodontic materials bonded to teeth. The first study that analyzed shear bond strength of orthodontic appliances appeared in international literature in the late 1970s. (1)

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. (2) 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. [3,4] 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.

The adhesion of glass-ionomers to the surface of the tooth is an important clinical advantage. Glass-ionomers are prepared from poly(acrylic acid) or related polymers, and this substance has been known to promote adhesion, because of the adhesion of the zinc polycarboxylate cement. [5] The advantage conferred by their adhesion was exploited many years ago, when glass-ionomers were proposed for the repair of cervical erosion lesions and as pit and fissure sealants. [6]

Tensile bond strengths of glass-ionomers to untreated enamel and dentine are good. [7] 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. [8] Hence, this study is conducted for glass ionomer cements as luting agents for orthodontic brackets.

Materials & methods

A total of 50 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 to the brackets and enamel in accordance with the manufacturers' instructions. They were classified as according to material transbond XT, GC fuji ortho LC and GC fuji ortho. Teeth were given conditions accordingly as dry, wet also the surface treated was conditioned or unconditioned. The cement with luting properties was taken as sample of 10 teeth showing luting of capping a crown was also considered. The data was collected and evaluated. Results obtained were carefully studied an compared. Complete analysis was done using SPSS software.

Results

Different groups with each of 10 teeth were considered to study. Mean shear bond strength and all glass ionomer cement test conditions were noted. The shear bond strengths of the autopolymerizing GC Fuji Ortho were consistently higher than those recorded for Fuji Ortho LC under all enamel surface preparation conditions. The results also showed that wet unconditioned surfaces consistently produced higher shear bond strengths than dry unconditioned surfaces. Wet or dry conditioned surfaces, however, produced higher shear bond strengths than unconditioned wet or dry surfaces. 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.

Table 1: Mean shear bond strengths and all glass ionomer cements test conditions

Groups and materials	Environment	Surface treatment	Mean SBS		
			N	24hr	7d
Control Transbond XT	Dry	Etched (37% phosphoric acid)	10	21.36	26.39
Case Fuji ortho LC	Dry	Conditioned	10	14.60	12.58
Fuji ortho LC	Dry	Unconditioned	10	1.83	2.30
Fuji ortho LC	Wet	Conditioned	10	13.06	17.62
Fuji ortho LC	Wet	Unconditioned	10	4.23	12.38
Case GC fuji ortho	Dry	Conditioned	10	15.30	18.36
GC fuji ortho	Dry	Unconditioned	10	4.18	3.01
GC fuji ortho	Wet	Conditioned	10	14.06	18.53
GC fuji ortho	Wet	Unconditioned	10	6.36	12.30
GIC luting		Capping crown	10	6.01	-

Discussion

A bonded bracket must withstand both the forces of mastication and the orthodontic forces that it is subjected to in the oral environment. It is also a clinical requirement that the bond should reach sufficient strength shortly after bracket bonding to allow archwire placement at the bonding appointment. This mechanochemical bond must be durable enough to last over the period of active treatment. It has been established that tensile bond strengths of adhesives in the range of six to eight MPa are required for successful clinical bonding. (9,10)

In present study, different groups with each of 10 teeth were considered to study. Mean shear bond strength and all glass ionomer cement test conditions were noted. The shear bond strengths of the autopolymerizing GC Fuji Ortho were consistently higher than those recorded for Fuji Ortho LC under all enamel surface preparation conditions. The results also showed that wet unconditioned surfaces consistently produced higher shear bond strengths than did dry unconditioned surfaces. Wet or dry conditioned surfaces, however, produced higher shear bond strengths than did unconditioned wet or dry surfaces.

One of the study was done to assess 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.

Another study 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. [(12)]

In the literature, there are not clear guidelines about shear force limits, but in fact a good orthodontic biomaterial should allow good adhesion in order to sustain masticatory forces (with a minimum bond strength of 5–10 MPa). [(13)] On the other hand, adhesion forces should not be too strong in order to avoid enamel loss after debonding (40–50 MPa). [(14)]

Conclusion

The results of this study suggest that glass ionomer cements provide sufficiently high shear bond strengths to retain orthodontic brackets under clinical conditions.

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