10.5005/jp-journals-10024-1203

ORIGINAL RESEARCH

Glass Ionomer Cement as an Orthodontic Bonding Agent

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ABSTRACT

Aim

- To find an alternative to popular orthodontic bonding agent composite resin and elimination of acid etching.
- To assess GC Fuji Ortho as an orthodontic bonding agent under different enamel conditions and evaluate the shear bond strength.
- Enamel surfaces intentionally contaminated with saliva, conditioned enamel using Fuji dentin conditioner and conventional 37% phosphoric acid/60 seconds.
- To evaluate and compare shear bond strength to a 'gold standard' composite bonding agent—Rely-a-Bond.

Materials and methods: The sample consisted of 50 human premolar teeth collected and stored in formalin. Out of 50 samples, 38 were upper premolars and 12 were lower second premolars. The total sample divide into 10 each. Stainless steel contour bracket with bondable mesh measured about 3.42 mm in length and 3.31 mm in width. Each tooth sample was embedded in a cylindrical acrylic block of polymethyl methacrylate (PMMN). The buccal surfaces of all the samples were polished with fluoride-free pumice and rinsed thoroughly. 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.

Result: 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.

Conclusion: GC Fuji Ortho can be used as a bonding agent on etched enamel. Unetched, uncontaminated enamel surfaces were inadequate for bracket bonding.

Clinical significance: Potential benefits of glass ionomer cements can be utilized in orthodontic bonding.

Keywords: Self-cure glass ionomer cement, Bonding, Composite acid-etch.

How to cite this article: Ali H, Maroli S. Glass Ionomer Cement as an Orthodontic Bonding Agent. J Contemp Dent Pract 2012; 13(5):650-654.

Source of support: Nil

Conflict of interest: None declared

INTRODUCTION

Rapid stride in development of science and technology have revolutionized the basic outlook, approach and solutions to the problems in density. Technological advances always have the potential to generate shifts in paradigms. Adhesive[1] bonding technique, which has been practiced successfully for over 30 years, is one such typical case. Advances in bonding[2] systems and improved resin cements have opened a new era, typified by an ultra conservative approach while maintaining clinically effective and useful bond strengths.

Orthodontists use the acid etch bonding technique as a primary means of attaching brackets to the enamel surface. Composites are the mainstay of bonding today. They, however, have some drawbacks.[22] Search has been in progress for better alternatives. Glass ionomer cements (GIC) hold promise as an alternate. Recent advances in the technology permits GIC;[3] its usage without etching and absolute moisture control is not a critical requirement. Further, GICs release fluoride which help to reduce enamel demineralization. Debonding procedure is easier with GICs and chemical adhesion with enamel is a significant advantage.

The present study aims to assess GC Fuji Ortho (Fig. 1) as an orthodontic bonding agent[4] under different enamel conditions and evaluated against a commonly used composite bonding agent[6] and acid etching system.

To evaluate the shear bond strength of GC Fuji Ortho on:

1. Unetched uncontaminated enamel.
2. Enamel surface intentionally contaminated with human saliva.
3. Conditioned enamel using Fuji dentin conditioner.
4. Conventional 37% phosphoric acid/60 seconds.

To evaluate and compare shear bond strength to a 'gold standard' composite bonding agent—Rely-a-Bond.[1-4]

Fig. 1: GC cement for orthodontic bonding

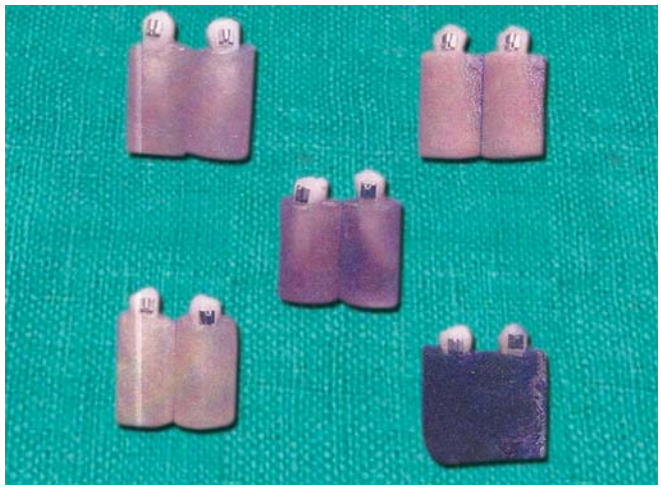


Fig. 3: Specimen bonded with the brackets

MATERIALS AND METHODS

This study aims to evaluate the physical properties of GC Fuji Ortho self-cure glass ionomer.[7,8]

The sample consisted of 50 human premolar teeth (Fig. 2) extracted for orthodontic purpose, collected and stored in formalin at room temperature. The storage medium was changed periodically to eliminate the possible contamination. The collected teeth samples were healthy and without caries, unrestored, without any development defects of enamel surfaces and without morphological aberrations.

The surface of the root portion of the teeth samples were cleaned of soft tissue debris. Out of 50 samples, 38 were upper premolars and 12 were lower second premolars.

The total samples were divided into five groups of 10 each.

Stainless steel contoured brackets (Fig. 3) with bondable mesh were used. The base of the bracket measured about 3.42 mm in length and 3.31 mm in width. All the brackets were apparently of uniform size. Each tooth sample was embedded in a cylindrical acrylic block of polymethyl methacrylate (PMMA) so that the only crown portion was exposed. The crown was oriented along the long axis of the acrylic block so that the long axis of the crown was parallel to its block. The acrylic block was approximately 4 cm in length. The blocks were stored in distilled water at room temperature in a closed container.

The buccal surfaces of all the samples were polished with a mixture of water and fluoride-free pumice using a rubber polishing cup for 1 minute. The samples were thereafter rinsed thoroughly.

The buccal surfaces of all the samples were polished with fluoride-free pumice and rinsed thoroughly. Group 1 was bonded with GC Fuji Ortho after etched with 37% phosphoric acid/60 seconds. Group 2 was contaminated with saliva. Group 3 was conditioned with Fuji dentin condition. Group 4 was unetched, uncontaminated and Group 5 was treated with rely bond composite resin after getting etched with 37% phosphoric acid.

The shear bond strength was estimated using an Instron Universal Testing machine (Fig. 4). This machine utilizes a

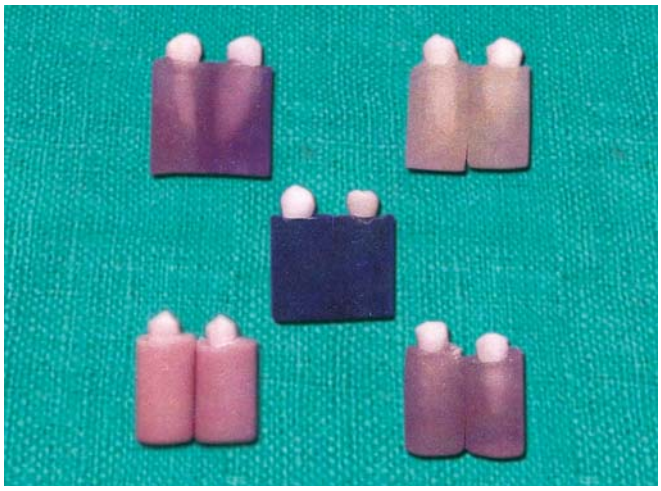


Fig. 2: Teeth mounted in PMMA cylindrical block

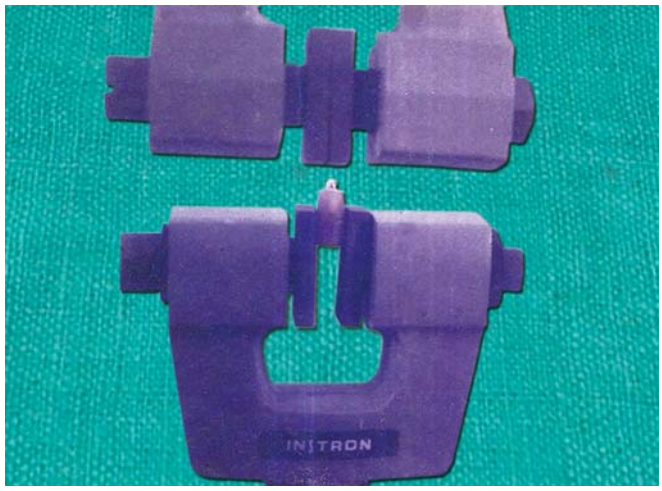


Fig. 4: Loading at the specimen for testine

sensitive load cell of 980 N capacity and maintains a constant rate of crosshead speed. For this particular study, the crosshead speed of the Instron machine was fixed at a constant speed of 0.5 mm/minute. The testing external environment was 50% humid and external room temperature was 25ºC. The force at which the bond failed was recorded on a XY recorder as the shear/peel bond strength of the material used for bonding. The force required for the bond failure was recorded in Newtons and tabulated for each group.

Readings obtained were statistically analyzed (Tables 1 to 5). The means and standard deviations of the force required for bond failure with different materials were calculated. Paired Students t-test (Table 6) was performed.

RESULTS

Rely-a-Bond showed the highest shear bond strength[18] in this study, i.e. 64.70 N. The next highest value was that of group 4 Fuji Ortho, etched with 37% phosphoric acid for 60 seconds, i.e. 63.49 N. Conditioning of the enamel with the conditioner gave a mean value of 34.82 N. The highest value was in the group that of Group 3 Fuji Ortho, conditioned with conditioner was 57.82 N. The teeth which

Table 1: Group 1 shear bond strength of GC Fuji Ortho etched

Sample no.	*Shear bond strength (in Newtons)*
1	42.79
2	51.89
3	36.70
4	33.68
5	29.25
6	63.49
7	34.21
8	24.25
9	32.68
10	62.15
Mean	41.109
Std. dev.	13.666
Std. err.	4.322
Maximum	63.490
Minimum	24.250
Range	39.240

Table 2: Group 2 shear bond strength of GC Fuji Ortho contaminated with saliva

Sample no.	*Shear bond strength (in Newtons)*
1	24.15
2	35.38
3	29.22
4	25.23
5	21.60
6	29.62
7	24.48
8	58.17
9	26.00
10	20.56
Mean	29.441
Std. dev.	10.971
Std. err.	3.469
Maximum	58.170
Minimum	20.560
Range	37.610

Table 3: Group 3 shear bond strength of GC Fuji Ortho conditioned

Sample no.	*Shear bond strength (in Newtons)*
1	30.71
2	20.78
3	23.30
4	48.80
5	44.47
6	57.82
7	35.06
8	29.09
9	22.56
10	35.59
Mean	34.818
Std. dev.	12.239
Std. err.	3.870
Maximum	57.820
Minimum	20.780
Range	37.040

Table 4: Group 4 shear bond strength of GC Fuji Ortho unetched, uncontaminated

Sample no.	*Shear bond strength (in Newtons)*
1	22.15
2	22.34
3	19.53
4	18.08
5	49.26
6	24.08
7	28.08
8	17.05
9	29.80
10	16.05
Mean	24.642
Std. dev.	9.758
Std. err.	3.086
Maximum	49.260
Minimum	16.050
Range	33.210

Table 5: Group 5 shear bond strength of composite resin Rely-a-Bond

Sample no.	*Shear bond strength in Newtons*
1	44.60
2	58.90
3	59.40
4	63.70
5	65.80
6	68.40
7	69.20
8	71.90
9	72.20
10	72.90
Mean	64.700
Std. dev.	8.674
Std. err.	2.743
Maximum	72.900
Minimum	44.600
Range	28.300

Table 6: Paired t-test for groups 1 to 4 as compared to group 5

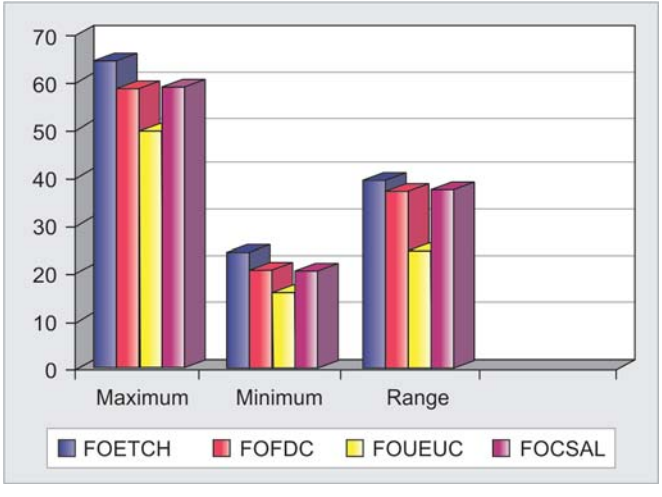
Gold standard	*Name of study material*	*t-value*	*Significance at 1% level*
Rely-a-Bond	GC Fuji Ortho UN etched	–10.04	Highly significant
"	GC Fuji Ortho saliva control	–8.78	"
"	GC Fuji Ortho conditioned	–6.95	"
"	GC Fuji Ortho etched	–4.53	Significant

were bonded on unetched, uncontaminated enamel, i.e. mean value of 29.44 N and the highest value 58.17 N. The lowest bond strength in this study showed in the group 1, i.e. unetched, uncontaminated enamel surface was that of mean value of 24.64 N. The second highest value of shear bond strength in this study was that of Group 4 etched with 37% phosphoric acid which gave a mean value 41.10 N.

SUMMARY AND CONCLUSION

The study was conducted to assess GC Fuji Ortho,[23] as an orthodontic bonding agent under different enamel condition and evaluated against a commonly used composite resin bonding agent and acid-etching system as the gold standard (Graph 1).[6,10,11] The shear/peel bond strength values were recorded in Newtons.

1. GC Fuji Ortho can be used as an orthodontic bonding agent provided the enamel is etched.
2. Composite resins[12,13] are still superior to glass ionomer cements[3,10,16-21] as regard to shear bond strength.
3. Bond strength of GC Fuju Ortho[14,15] glass ionomer cements on enamel surface conditioned with GC conditioner[5,7,9] will come within suggested minimum of 3 to 5 MPa.
4. GC Fuji Ortho[24] on unetched, uncontaminated enamel or contaminated with saliva was not adequate for orthodontic bonding.
5. Advantages of GIC, like fluoride[26] release, bonding to enamel tissue and metal is another landmark development as an alternate[25] well-established acid etch resin bond technique.



Graph 1: Minimum, maximum values and range for GC Ortho for etch/conditioning/unetch/uncontaminated/salivary contamination

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