A COMPARATIVE STUDY BETWEEN ESTHETIC AND ESTHETIC FLUORIDE RELEASED RESIN RESTORATIVE MATERIALS

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Abstract

The aim of this study was to compare the shear bond strengths of two compomers bonded with a single step bonding agent with two modern composites bonded with two different bonding agent. Bovine mandibular incisors were selected for use. Twenty specimens were prepared and grouped. The dentin surfaces were treated and the adhesive agents and restorative materials of each group were applied and condensed into a Teflon mold then light-cured and specimens stored at 37°C in distilled water for 24 hours. The specimens were tested in shear mode at a crosshead speed of 0.5 mm/minute until failure. The mean bond strengths were compared using one-way ANOVA. Statistical analysis was performed using Kruskal-Wallis Test followed by Turkey Type non-Parametric Post Hoc Test. The results showed that there were significant differences in the shear bond strength between the two types of compomers used. No significant differences in the shear bond strength of the two composite materials used. The statistical significance of the differences between the two types of composites compared with compomers was also investigated.

Introduction

Glass-ionomer (polyalkenoate) cements posses certain properties that make them useful as a multi-purpose restorative material. These properties include the release of fluoride ions into adjacent tooth structure (Swartz et al, 1994), a low coefficient of thermal expansion (McLean and Gasser, 1985; Craig, 1989), biocompatibility with dental tissues (Tobias et al, 1978; Heys et al, 1987), and physico-chemical bonding to both enamel and dentin (Hotz et al, 1977; Lacefield et al, 1985). Glass ionomers have gained acceptance as liners, luting agents, and core build-up materials, but their use as restorative materials has been less common (Reinhardt et al, 1993). Compared with composite resins, the glass ionomers are relatively unesthetic and have poor physical properties, including low flexural strength and fracture toughness (Walls, 1986; Wilson, 1989). Furthermore, they undergo a long and complex setting reaction and are easily damaged by excessive moisture or desiccation (Mount and Makinson, 1982; Walls, 1986; Wilson, 1989).

In order to overcome these disadvantages, several manufacturers have recently developed glass ionomer cement with composite to produce a variety of new materials, which as a hybrid of conventional glass ionomer cements and photocure composite resin, and now commonly used in restorative dentistry. These materials aim to combine the advantages of glass ionomers and composites in one material. Antonucci et al (1988); Mathis and Ferracane (1989) developed the first resin modified glass ionomer cements. In later research, a new compomer was developed that combined the chemistry, material properties, and working techniques of composites and glass ionomers. Krejci (1993) defined one brand of compomer (Dyract), which combines the polymers of composites with the characteristics of glass ionomers that may include adhesion to tooth structure and cariostatic properties due to fluoride release. However, all compomer systems provide dentin-bonding agents to provide bonding similar to that used with composites.

This in vitro investigation was designed to compare the shear bond strength of two esthetic fluoride resin restorative materials and two modern composite restorative materials to bovine dentin.

Materials and Methods

The materials tested were: two composites resin; Z-100 and Pyramid, and two compomers; Dyract AP and Compoglass F (table 1).

Twenty mandibular incisors extracted from (2-3) year old cattle were used as a substitute for human teeth and stored in de-ionized water at the refrigerator (Nakamichi et al, 1983). The labial surfaces of bovine incisors were ground on wet 240, 400-grit silicone carbide abrasive paper (SIC) on a wheel (Jean Wirtz Automat A Polishing Machine Dusseldorf, Germany) to flattened and exposed dentine surface. Each tooth was then mounted in cold-curing acrylic resin to expose the flattened area after removal of the root and was placed in tap water to reduce the temperature rise from the exothermic polymerization reaction of the acrylic resin. Final finish was accomplished by grinding on wet 600-grit SIC paper to remove the excess debris. Split Teflon molds were used, a 3.0mm high and 6.0 mm diameter for composites and a 2.0mm high and 4.0mm diameter for compomers to form and hold the materials to the teeth surfaces. A stainless steel ring was used to hold the split Teflon mold and specimen in place for each material. The prepared specimens were

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divided into four groups, 5 teeth each. The specimens of group 1 were pretreated with Scotchbond Multi-Purpose(SCMP) according to the manufacturers' directions. The dentin surface was treated with 35% phosphoric acid for 15 seconds, rinsed thoroughly for 15 seconds and air dried for 5seconds. The primer was applied and dried gently for 5 seconds. A layer of adhesive was brushed on the dentin surface and cured for 10 seconds, the Z-100 restorative material was condensed into the mold and cured for 40 seconds.

The prepared surfaces were pretreated with All-Bond 2 according to the manufacturer's directions. The dentin surface was treated with 10% orthophosphoric acid for 15 seconds, rinse thoroughly, and air dried for 1-2 seconds to remove excess water but still leave moist dentin. The primer A and B were mixed as prescribed and applied in 3-6 coats then dried for 5 seconds. Equal volume of the D/E resin and pre-bond resin were mixed and a thin layer brushed on the dentin surface and cured for 20 seconds, and the Pyramid restorative material was condensed into the mold and cured for 40 seeonds.

The specimens of Group 3 were pretreated with Prime and Bond NT and restored with Dyract AP according to the manufacturers' directions. The prepared area was rinsed and dried, then the first layer of adhesive was applied for 30 seconds, dried and cured for 10 seconds. The second layer of adhesive was applied, dried, cured for 10 seconds, and the Dyract was condensed into the mold and cured for 40 seconds.

The specimens of Group 4 were pretreated with Compoglass SCA and restored with Compoglass F. The prepared area was rinsed and dried, then the adhesive was applied on dentin 20 seconds, dried and cured for 20 seconds. Another layer of adhesive was applied, dried and cured for20 seconds then Compoglass F was condensed into the mold and cured for 40 seconds.

Bonded specimens from each group of materials were stored at 37°C in distilled water for 24 hours. Furthermore, each group was tested in shear mode using a shear knife-edge testing apparatus in an Instron testing machine (Type 8500, Instron Corp., Kanton, Massachusetts, USA) at a crosshead speed of 0.5 mm/min. Shear bond strength values in MPa were calculated from the peak load at failure divided by the specimen surface area.

The results were analyzed by calculating the mean shear bond strength (MPa) and standard deviation for each group using Statistical Personal Social Science (SPSS). The data for each group were tested for homogeneity of variance using Kruskal-Wallis Test, and then subjected to one-way ANOVAs followed by Turkey Type non-parametric Post Hoc Test at $P<0.05$ to make comparisons among the four treatment groups of each bonding system.

Table 1: Materials and manufacturers

Material	*Pre-Treatment*	*Manufacturers*
Z-100	*Scotchbond Multi-Purpose*	*3M Dental Products, St. Paul, MN, USA*
Pyramid	*All-Bond 2*	*Bisco, Inc. Schaumburg, IL. 60193*
Dyract AP	*Prime & Bond NT*	*Dentsply, DeTrey, Konstanz, Germany*
Compoglass F	*Compoglass SCA*	*Vivadent Ets. Schaan, Liechtenstein*

Result

The mean shear bond strength of each of the four materials is presented in Table 2 and was illustrated diagrammatically in Fig.1. The recorded values of the shear bond strengths of the two compomers materials used were 10.7 MPa for Dyract and 5.7 MPa for Compoglass F. Evidently, there was a significant statistical difference between the two brands tested. However, for composite restoratives used, there were no significant statistical differences between the two brands. It was 13.7 MPa for Z-100 and 10.3 MPa for Pyramid. In addition, there were no significant statistical differences between the Compomer Dyract if compared with the two composites used. However, Compoglass F compomer materials showed a significant statistical difference if compared with the former three brands tested (Table 3).

Table 2: Mean shear bond strengths (Mpa)

Materials	*Mean*	*SD*
Z-100	*13.7*	*±3.0*
Pyramid	*10.3*	*±1.5*
Dyract	*10.7*	*±3.6*
Compoglass F	*5.7*	*±1.1*

Values connected by the line are not significantly different (α =0.05) at 5% significant level.

Table 3: One-way analysis of variance

Source	*Df*	*F-Value*	*Significance*
Between Groups	*3*	*8.5*	*0.001*

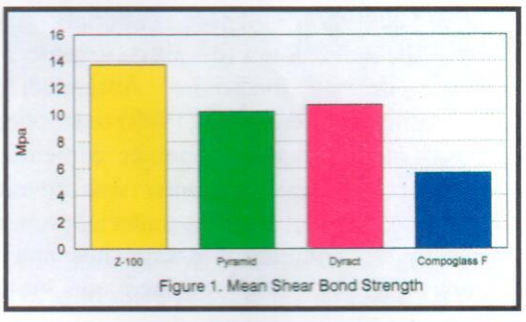

Fig.1: Mean shear bond strength

Discussion

The result of the present investigation revealed that, the shear bond strength of Dyract and Compoglass' F had a statistical significant difference. It was 10.7 MPa and 5.7 MPa, respectively (Table 2). This difference could be due to the differences in the composition of their single bonding agent and the highest value was with Dyract compomer. This could be explained on the basis of the contained acidic monomers on the self-conditioning agent of the primer and that make it primer and bonding agents. However, improvement in the bond strength of compomers can be attributed to the improvement of their physical properties due to addition of resin monomer. In addition, the primer or conditioner that supplies with compomer may removes or modifies the smear layer and consequently enhances the penetration of resin monomer to dentinal tubule resulting in micromechanical retention (Hotz et al, 1977 and Friedle et al, 1995). This may explain the strong adhesive properties of Dyract compomer. This was in agreement with Schneider et al (2000). Contrary to Compoglass F compomer which is a single component adhesive that was a water base and contain the weak maleic acid and HEMA (Krejci, 1993).

The value of the shear bond strength of the two composites tested showed no statistical significant differences in their values. It was 13.7 MPa for Z-100 and 10.3 MPa for Pyramid. However the comparison between the two composites, (Z-100, Pyramid), used and compomers restorative showed no statistical differences between these materials and Dyract compomer. Perhaps the adhesive system of Dyract compomer (prime and bond) may adequately simulating the adhesive system of the two composites used (etching, priming and bonding). The explanation was based on the hypothesis that the physical properties like the elastic modulus of composites affect the bond strength of adhesion, which could also be considered (Von Noort et al, 1989).

It is apparent that compomers can play a useful part in restorative dentistry. No material is universal, and it is unlikely that such an ideal will ever be achieved. All our current materials have limitations, but each one used to its full potential, has a place.

Conclusions

Under the conditions of this in vitro study the following conclusions could be drawn:

1. The improvement of the shear bond strength of some of compomer is due to the improvement in their self-conditioning primer and bond.
2. With the improvement in the shear bond strength of compomers, its adhesive property simulates the bonding properties of composites.

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