ASSESSMENT OF RETENTIVE STRENGTH OF ORTHODONTIC BANDS CEMENTED WITH GLASS IONOMER CEMENT CONSISTING OF HY AGENT (TANNIN FLUORIDE): AN IN-VITRO STUDY

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Abstract

Introduction: Glass ionomer cement consisting of HY agent- a tannic acid-strontium fluoride-zinc fluoride complex, has claimed to promote re-mineralization, increase acid resistance, and reduce solubility hence providing greater retentive strength.

Aim: This in vitro study was to compare and evaluate the retentive strength of orthodontic bands cemented with HY agent-containing glass ionomer cement (Shofu HY Bond) versus conventional glass ionomer cement (Voco Meron).

Materials and Methods: Forty extracted mandibular first molar teeth were embedded in acrylic resin blocks with the buccal surface of crowns perpendicular to the base of the blocks. Twenty teeth were banded with Shofu HY bond GIC (group 1) and the next twenty teeth were banded with Voco Meron luting GIC (group 2). After thermocycling (3000 cycles, 5° to 55°C) the retentive strength of both the groups of GICs were assessed using a universal testing machine with a crosshead speed of 1mm/minute. An independent sample t-test was performed to compare the retentive strength of the two groups.

Results: The mean retentive strength of bands cemented with Shofu HY bond GIC was 12.50 ±1.36 MPa and with Voco Meron luting GIC was 12.34 ±1.52 MPa and did not differ significantly.

Conclusion: There was no difference in the retentive strength of bands cemented with Shofu HY bond GIC and Voco Meron luting GIC.

Keywords: Glass ionomer cement, retentive strength, Glass ionomer cement containing HY agent, Tannin-Fluoride preparation, Adhesiveness

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1. Introduction

Orthodontic bands are placed around the crowns of posterior teeth to provide stable attachments for affecting tooth movement. (1,2) Although bonding of brackets using composite resin and the acid-etch technique has become common practice, metal bands continue to be used particularly on molars, due to the high bond failure rate of molar tubes and the use of other attachments, such as headgear. (3)(4,5) Glass ionomer cement (GIC) remain the most commonly used luting agent for cementation of orthodontic bands. The retention of the bands is essential to the success of orthodontic treatment because they are placed in the posterior region, where they are subject to the greatest shear and tensile forces from mastication or trauma. (6)(7) Optimally, the retentive strength of bands provided by the orthodontic cement is sufficient to prevent debonding.(1)

The most common cement for band cementation was zinc phosphate, but polycarboxylate cement was also used because of its high intraoral solubility and mechanical adhesion for its retentive effect. Although effective in relation to Stainless steel and enamel, its high viscosity, short setting time, and high intraoral solubility were major drawbacks that led to the application of GIC in its stead.

Introduced in 1971 by Wilson and Kent, favourable properties of glass ionomer cement (GIC) encompassed low solubility in oral fluids, higher strength; compressive and tensile, and the ability to chelate, via an acid-base reaction to bond to enamel and dentin and, form ionic bonds with stainless steel. (8–10) However, GIC is brittle and susceptible to attack by water during its setting, resulting in a compromised bond. A further innovation, resin-modified glass ionomers (RMGI), combines the properties of glass ionomers as well as the additional strength afforded by its composite resin component resulting in enhanced bond strength.

Shofu HY bond glass ionomer cement and Voco Meron glass ionomer cement were used for the cementation of the bands. Shofu HY bond GIC contains HY-agent, a tannic acid-strontium fluoride-zinc fluoride complex, fluoro aluminosilicate glass and acrylic acid tricarboxylic acid copolymer solution. (11) Voco Meron GIC is a glass ionomer luting cement composed of polyacrylic acid, fluoro-silicate, and parabens.

Evaluating the retentive strength of various commercially available GICs are crucial. Hence this study was framed and conducted to evaluate and compare the retentive strength of orthodontic bands cemented with Shofu HY bond GIC and Voco Meron luting GIC. The null hypothesis tested is that there is no difference in the mean retentive strength of orthodontic bands cemented with Shofu HY bond GIC and Voco Meron luting GIC. (12)

2. Materials and methodology

Study design

In this in vitro evaluation, 40 extracted human mandibular first permanent molars were used. Teeth with intact buccal and lingual enamel without any cracks, surface demineralization nor frank cavitation were selected. After extraction, no chemical agent was used to store the teeth. Following a thorough cleaning, these teeth were polished with non-fluoridated pumice paste and a bristle brush before being stored in distilled water and left at room temperature until testing. Using chemically cured acrylic resin, the roots of the teeth were encased in a cylindrical mould. The buccal surface of each tooth was positioned with a surveyor so that it was perpendicular to the base of the mould. First molar bands made of standard stainless steel with buccal tubes were chosen and clinically modified to fit each tooth's crown. Following a 30-second cleaning and washing in distilled water, the teeth were dried in a stream of dry air. To cement the band, the teeth were then randomly split into two groups of 20 each.

Banding procedure

Glass ionomer cement was used to cement the bands of the two groups. Shofu HY- Bond GIC (Gold label; GC Corporation, Tokyo, Japan) was used to cement the bands to the teeth surfaces in group 1 while Meron luting GIC (Voco, Germany) was used to cement the bands to the teeth surfaces in group 2. The manufacturer's instructions were followed in preparing the cement. The accompanying measuring spoon was used to measure precisely one level scoop of powder and placed on the mixing pad and one drop of liquid was dispensed. The powder and liquid were mixed gently by folding the powder into the liquid for 15 seconds. A stainless steel band seater was used to manually seat each orthodontic band on each tooth after it had been loaded into the band. The banded teeth were then subjected to thermocycling (3,000 cycles in water baths between 5°C and 55°C) after the GIC was completely set. Following thermocycling, the retentive strength of each specimen in the two groups was evaluated using a universal testing machine with a crosshead speed of 1 mm/min. A special jig was made to mount each tooth and clamped to the holding device and fixed

to the lower load cell of the universal testing machine. The holding device's arrowheads completely encircled each band's buccal tube and lingual sheath. Due to this arrangement, all debonding forces could be applied parallel to the tooth's long axis. The force was applied till the band was detached from the tooth. The maximum force recorded (in Newtons) during debonding was determined from the stress-strain curve for each specimen and divided by the band surface area (in square millimetres) to determine the bond strength values in megapascals (MPa).

Statistical analysis

Shapiro-Wilk test was done to calculate the cumulative frequency (normalized by the sample size) before the statistical evaluation of retentive strength. Descriptive statistics, including the mean, standard deviation, and minimum and maximum values were computed for retentive strength for each group. An Independent sample t-test was done to assess the statistical difference between the mean of the two groups

3. Results

The mean retentive strength of bands cemented with Shofu HY bond GIC was 12.50 ±1.36 MPa and with Voco Meron luting GIC was 12.34 ±1.52 MPa. An independent sample t-test demonstrated that there was no statistically significant difference in the retentive strength between the two types of GICs (*P*= 0.57)

	Number of samples	Mean	Std. deviation
Group 1	20	12.50	1.36
Group 2	20	12.34	1.52

Table 1: Descriptive statistics (in megapascals) of the retentive strength of experimental groups

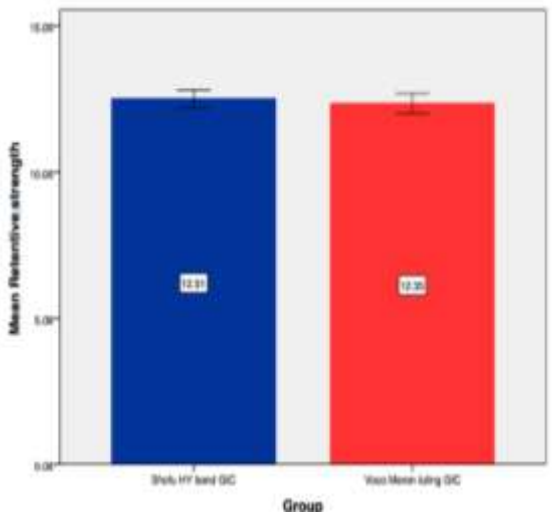

Figure 1: Mean retentive strength between the two groups of GICs

4. Discussion

Orthodontic cement has been used to improve retention between the band and the molar, but unfavourable characteristics, such as high oral fluid solubility and low bond strengths, lead to debonding during treatment, which lengthens the overall treatment time or may contribute to demineralization beneath bands. (13–15) The shear bond loads in an occlusal direction are the main cause of cement failure between the band and the crown. (3) Very few previous investigations have analyzed the clinical performance of GIC-containing HY agents. This in vitro study was performed to compare and evaluate the retentive strength of orthodontic bands cemented with HY agent-containing glass ionomer cement (Shofu HY Bond) versus conventional glass ionomer cement (Voco Meron). In this study, it was observed that there was no statistically significant difference in the retentive strength between the two groups of

GICs. The mean retentive strength of bands cemented with Shofu HY bond GIC was 12.50 ± 1.36 MPa and with Voco Meron luting GIC was 12.34 ±1.52 MPa. Previous in vitro studies have reported on the retentive strength between conventional GIC and GIC-containing HY agent. Farret *et al.* (2012) performed an in vitro study assessing the mechanical properties of glass ionomer cements for orthodontic cementation. Two conventional glass ionomers (Ketac Cem Easy mix/3M-ESPE and Meron/Voco) and one resin-modified glass ionomer (Multi-cure Glass ionomer/3M-Unitek) were selected for the study. The results showed that the Multi-Cure Glass Ionomer presented higher diametral tensile strength ($p<0.01$) and compressive strength greater than conventional GICs ($p= 0.08$). It was concluded that the resin-modified glass ionomer cement showed high mechanical properties, compared to the conventional glass ionomer cement(6). Yamaga *et al.* performed an in vitro study comparing the adhesiveness of Glass Ionomer Cement containing various ratios of tannin-fluoride preparation (HY agent) to dentin. It was found that the bond strength on the first day was increased by the incorporation of a 1.5% HY agent in the GIC. There was a decrease in the bond strength over time for all of the mixtures, and no difference was observed between cement that contained the agent and those that did not. Likewise, no difference was observed among the cement containing various ratios of the incorporated agent. (16) Retentive strength of bands cemented with conventional GIC and GIC containing HY agent reported in previous studies did not show much difference in the retentive strength and can be considered for clinical use.

Limitations

It was an in-vitro study, conducted on extracted teeth which does not simulate the oral environment accurately. Fixed orthodontic treatment requires a longer duration for completion of the treatment hence the properties of solubility of the glass ionomer cement must be evaluated.

5. Conclusion

Both conventional and HY agent containing GIC had a good retentive strength required to prevent debonding.

Conflict of Interest: Nil

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