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Comparison of retention rate for fissure sealing between glass ionomer and resin composite

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Abstract

Background: *The aim of present research was to evaluate the comparison of retention rate for fissure sealing between glass ionomer and resin composite*

Methods: *Metallic brackets were bonded with resin composite orthodontic adhesive (Transbond XT; 3M Unitek, Monrovia, Calif) or a glass ionomer cement (Fuji I; GC, Tokyo, Japan) to recently extracted premolars and kept in water for 6 months. The same materials were also bonded to the premolars of orthodontic patients. All teeth were embedded in epoxy resin and sectioned buccolingually. Fourier transform infrared microscopy and Raman microscopy were used for the estimation of the degree of cure in the composite and the salt yield in the glass ionomer adhesives.*

Results: *In the study, 32 handicapped patients were selected, 5 autistic patients [15.62%], 9 with Down syndrome [28.12%], 6 with cerebral palsy [18.75%], and 12 with slight to moderate mental retardation [37.5%]. The patients were distributed amongst two groups; 11 physically and psychologically challenged patients [34.4%], and 21 exclusively with psychological disability [65.6%]. Composite showed significantly lower degrees of cure than did the retrieved specimens (52.40% 6 3.21% vs 57.62% 6 1.32% by Fourier transform infrared microscopy, and 61.40% 62.61% vs 67.40% 6 3.44% by Raman microscopy).*

Raman microscopy significantly overestimated the degree of cure and failed to provide reliable information for the salt yield in the glass ionomer cement. Fourier transform infrared microscopy showed increased.

Conclusions: *Enhanced oxidation of residual carbon bonds in the composite and a little improved suspension of the weaker calcium salt phase in the glass ionomer cement were the main differences in the intraorally aged specimens in comparison with the specimens stored in water.*

Keywords: fissure sealing, glass ionomer, resin composite

INTRODUCTION

According to the World Health Organization, there are over a billion people in the world living with some kind of disability. Almost 200 million of them experience considerable difficulties to function. Many systemic diseases, disabling conditions, and medical treatments may reduce the caries resistance of the patient. Actually, these patients are more prone to suffering from caries due to motor coordination problems that hinder or difficult mouth hygiene, lack of care on the side of the people that look after them, ingestion of a big number a medications that favor xerostomy, and excessively bland diets.[1]

The traditional orthodontic adhesives for bracket bonding are resin composite materials, introduced in the mid-1970s. These orthodontic adhesives have been used successfully on acid-etched enamel over the last 40 years. The development of visible light-cured materials offered additional advantages in the field ie, high early bond strength,2 minimal oxygen inhibition,3 and prolonged working time for optimal bracket placement which have brought innovation and practicality to modern orthodontic treatment. Disadvantages of the resin composite adhesives include loss of enamel during acid conditioning,4 loss of the superficial fluoride rich enamel zone during debonding,5 and demineralization of enamel around the brackets because of poor patient compliance with respect to oral hygiene.[6,7] The importance of the curing efficiency on the performance of resin composites has long been documented. It has been shown that the degree of cure (%DC, the amount of carbon-carbon bonds reacted after setting) of resin composites modulates the composite's physical and mechanical properties,[8,9] color stability,[10] solubility and degradation,[11] and biocompatibility.12 Glass ionomer cements possess unique benefits that make them useful in clinical orthodontics. They chemically adhere to both enamel and metal, [13,14] release fluoride with its known caries-inhibiting properties,[15,16] and can absorb fluoride from sources such as fluoride solutions, thus recharging their fluoride reservoir.[16]

The use of sealants on pits and fissures is still one of the most widely accepted methods by the new cavity-prevention programs, as 80% of them develop in the pits and fissures of the tooth, due to the favorable conditions for the accumulation of plaque, and because it is a place in which fluoride cannot act. Sealants must be placed between 1 – 1.5 years post eruption, as this is the period considered to be critical, because the enamel is not com pletely ripe.[2-9]

Several clinical studies have shown that resin-based sealants that have been used since their introduction in the market in 1965 by Cueto and Buonocore, are nothing but a physical barrier that prevents the metabolic exchange between microorganisms of pits and fissures, and the mouth environment. Also, the application of resin-based sealants is a very humidity-sensitive technique, in which contamination could be equal to treatment failure. This very common contamination in the mouth cavity is very hard to control in special patients, because of the impossibility of collaboration on the side of the patient.[10-12] In 1974, glass ionomers were introduced by Mclean and Wilson. They have the peculiarity of releasing fluoride in the tooth and saliva, even a year after it has been placed.[10,13] It was then proposed as a sealant for pits and fissures in not very cooperative children, in hard to isolate teeth, in semi-erupted first molars, or as a transitional sealant.[9,11]

Unlike the short effect on the dental enamel of topically applied fluoride, glass ionomer sealants trigger a spreading mechanism by which mouth fluid anions are attracted by the opposite charges, performing an exchange with the fluoride, spreading it to the surface and liberating it. This mechanism allows for proper physical properties and fluoride release from days up to years, decreasing the occurrence of caries after the acid attack up to 35%, and is even capable of reducing demineralization to a few millimeters of the material.[14]

The literature has reported a decrease in enamel solubility and artificial secondary caries with fluoride dental materials, preventing demineralization and promoting mineralization.[14] Another advantage of using glass ionomers as sealants is the decrease in work time, as the acid does not need to be etched to achieve the chemical bonding to the tooth. This time, in the case of patients with disabilities, is of vital importance, as in most cases work is very complicated, and sometimes physical restraints are necessary.[6,13]

Although a lower retention of glass ionomer sealants has been reported, compared to resin-based sealants, the caries prevention effect is significantly higher with the ionomer, as it releases important concentrations of fluoride that penetrate up to 60 µm into the tooth enamel. However, with the development of resin modified photo polymerizable ionomers, this disadvantage has been minimized.[2,6,13,14]

The purpose of this study was to assess the effect of 6 months of intraoral aging on the setting efficiency of resin composite and conventional glass ionomer orthodontic adhesives relative to control specimens stored in water. The null hypothesis tested was that there is no difference in the setting status between laboratory and intraorally aged resin composited glass ionomer orthodontic adhesives.

MATERIALS AND METHODS

This study was made at a Dentistry department BMC/SPH, Quetta. The evaluations, placement, and reviewing of the sealants were performed. The control sample consisted of 14 sound premolars, recently extracted for orthodontic reasons and kept for 1 week in distilled water with the addition of 0.5% sodium azide at 8oC.

The teeth were randomly classified into 2 groups of 7 specimens each, cleaned and polished with a no fluoride paste. Metallic brackets were bonded to the middle buccal enamel surfaces with a conventional glass ionomer cement (Fuji I; GC, Tokyo, Japan) or a composite resin adhesive (Transbond XT; 3M Unitek, Monrovia, Calif). Glass ionomer cement was placed directly on blot-dried enamel. The resin composite adhesive, used without primer or bonding resin, was applied on air-dried, acid-etched (for 30 seconds) enamel with a 35% phosphoric acid gel (Transbond XT etching gel, 3M Unitek) and photopolymerized from the incisal and cervical bracket edges (10 seconds each) with a halogen light-curing unit (850 mW/cm 2 standard light intensity, Trilight; 3M ESPE, Seefeld, Germany). The tip of the unit was placed in contact with the bracket edges at approximately a 45 angle. All teeth were stored in 200 mL of distilled water at 37 C for 6 months. The water was replaced once a month to prevent saturation from leachable components. The test sample consisted of specimens obtained from patients recruited in the Graduate Orthodontic.

The materials used in this study were Clinpro Sealant 3M Dental, resin sealants and Vitremer, 3M Dental, a resin-modified photopolymerizable glass ionomer. These materials were used on the first four permanent molars in a collateral manner, in order to diminish the saliva contamination variable, due to the higher isolation difficulties in some areas.

Patients were selected randomly from the total population of children that attended the office during a previous period of three months, at the beginning of the study. The inclusion criteria included the psychological disability diagnosis of the patient, the presence of the four permanent molars - completely erupted and with no cavities, in a post-eruptive period not higher than two years -, the absence of bruxism, and an informed consent from the legal guardian. The children with hypoplastic permanent first molars or developmental anomalies were excluded from the study.

For the glass ionomer cement, the following peaks were used to monitor the acid-base reaction: the carboxyl peaks of polyacrylic acid (1740 cm1) and tartaric acid (1730 cm1), and the peaks of calcium polyacrylate (1540 cm1), aluminum polyacrylate

(1610 cm1), calcium tartrate (1595 cm1), and aluminum tartrate (1670cm1).21,22 Because the carboxyl groups are completely neutralized during the early setting stages of conventional glass ionomers, the salt yield was calculated by measuring the ratio of the peak areas of aluminum salts (1700-1600 cm1) to calcium salts (1600-1500 cm1) using the tangent baseline technique and the same analysis mode as above (4 regions perspecimen).

RESULTS

In the study, 32 handicapped patients were selected, 5 autistic patients 15.62%, 9 with Down syndrome 28.12%, 6 with cerebral palsy 18.75%, and 12 with slight to moderate mental retardation 37.5%. The patients were distributed amongst two groups; 11 physically and psychologically challenged patients 34.4%, and 21 exclusively with psychological disability 65.6%. It was determined that 90.6% followed a normal diet, and 9.4% a bland diet. 25% of the patients were treated with behavioral management, 6.3% also required the use of a retractor, 50% of the patients needed physical restraints, and 18.8% was prescribed with oral benzodiazepines. Retention levels were evaluated considering 3 criteria: present, partially present, and lost (Table 1). The clinical condition of the materials used was evaluated after three and six months. After three months, 65.62% of the resin-based sealants were present, as well as 70.31% of the glass ionomer sealants. On the other hand, 21.87% of resinous sealants, and 25% of glass ionomer sealants had been lost. In terms of the position of the tooth, 64% of the upper pieces showed a totally retained sealant, regardless of the material used; unlike lower pieces, in which the sealant was found totally retained on 48.43% of the cases.

In terms of the presence of caries, none of the teeth, even if they had lost the sealant, showed caries during the clinical exam (Table 1).

Besides the evaluation of retention based on the afore-mentioned criteria [present, partially present, and lost], the data was separated in two groups [success, failure], where only sealants found to be completely present were considered a success, and the other two criteria were considered failures. With this analysis it was determined that 67.18% of the resinous sealants and 70.31% of the glass ionomer sealants were successful after three months. After six months, 57.81% of the resin-based sealants and 51.56% of the glass ionomer sealants were successful (Table 2).

When performing the Chi-square statistical analysis [P<0.05] it was determined that there was a statistically significant relationship, where the glass ionomer was more effective. However, no statistical significance was observed after 6 months.

Figure 1: Evaluation of retention levels considering present

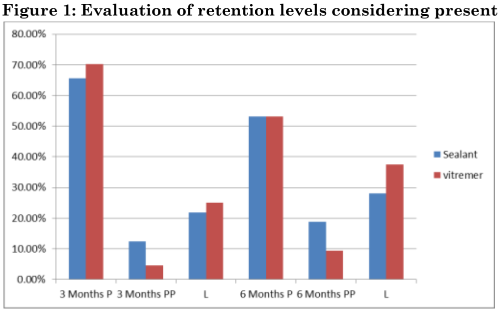

Table 1. Evaluation of retention levels considering present, partially present, and lost criteria.

	Time / Scores	Sealant	Vitremer
Significant Statistically ($P<0.05$)	3 months	0.006	0.001
	6 months	0.211	0.803
Presence of caries	3 month A	100%	100%
	P	0%	0%
	6 months A	100%	100%
	P	0%	0%

Table 2. Analysis of the data separated in two groups: success and failure.

Criteria	Time / Scores	Sealant	Vitremer
Retention	3 months Success	67.18%	70.31%
	Failed	32.81%	29.68%
	6 months Success	57.81%	51.56%
	Failed	42.18%	48.43%

DISCUSSION

Dental sealants have been proved to be highly effective in the prevention of pit and fissure caries. The caries preventive property of sealants is based on the placement of a seal that prevents nutrients from reaching the micro-flora in the fissure.[4] Many researchers have confirmed that ionomeric glass has many advantages if used as a sealant for pits and fissures in recently erupted teeth, as it has similar effects in terms of caries prevention; however, it is easier to handle, and the etching with acid is not necessary.[4]

This study compared the clinical success of a resin-based and glass ionomer sealants, used to seal pits and fissures on permanent first molars of 32 handicapped children, which were evaluated after 6 months.

In our study, at the end of the Six months period, resin-based sealants showed a total retention of 53.12%, partial retention of 18.75%, and 28.12% had been completely lost. In terms of the ionomer glass sealants, this study determined that 53.12% were present, 9.37% were partially retained and 37.5% were absent. Poulsen et al.[12] performed a study in which they compared the retention of a resin-based sealant with a glass ionomer sealant, and found that, after 6 months, 90.09% of the resin-based sealants were completely retained, 6.75% were partially retained, and 3.15% had been completely lost. Glass ionomer sealants were found to be present in 13.06% of the cases, partially retained 38.10% of the times, and absent in 50% of the teeth. Similar results were obtained by Forss et al.13, after comparing the retention of a resin-based sealant, and of a glass ionomer cement.

The results were 10.3% of the glass ionomer sealants, and 45.5% of the resin-based sealants were totally present, showing a statistically significant retention difference. Also, Subramanian et al.[4] determined a retention percentage of 38.3% after 6 months for resin sealants, and 13.1% for glass ionomer sealants. These results show a higher retention in the teeth in which a resin-based sealant was used; unlike our study, in which the results were similar for both materials after 6 months, although after 3 months statistical differences were found, with a higher retention for Vitremer sealants. Likewise, Guler et al.[10] found a higher retention after 6 months for glass ionomer sealants, with 82%, versus 73% for resin sealants. Pardi et al.[9] evaluated the clinical retention of two glass ionomer sealants [Vitremer and Ketac-Bond], and found a higher retention with Vitremer with the pas-sing of time: an evaluation after 2 years found 14.2% present, compared to 3.5% of Ketac Bond.

Regarding caries prevention, in our study, clinical evaluation after six months determined the absence of caries in 100% of the teeth, even though many of them had lost the sealant.

The possible reasons for failure of a resin sealant can be poor placement technique [inadequate etching, rinsing or drying, and insufficient curing time], the position. Notwithstanding numerous invitro studies, little is known about adhesives behaving at true clinical conditions. In this study, the bonded premolars remained in the subjects' mouths for 6 months, thus experiencing the invivo environment, before being extracted and tested. The split-mouth design, by the symmetric bonding of the 2 orthodontic adhesives at each patient's premolars, was an important prerequisite enabling both materials to be tested on teeth with the same morphology under the same intraoral conditions. Moreover, the water stored specimens were used as the controls, since in many experiments water storage has been used as an aging medium. The light cured orthodontic adhesive tested is a commonly used resin composite for bracket bonding.

The glass ionomer cement used is indicated for bonding orthodontic appliances and bands. We used the same product for bracket bonding instead of the proposed resin modified glass ionomer analog (Fuji Ortho LC, GC) to clearly identify the effect of the immersion environment on individual reactions (free radical in composite, acid base in glass ionomer), without the complex spectral interferences produced from dual set materials 23 Nevertheless, this should not be considered as a contraindication, since conventional glass ionomers are still used for bracket bonding.[16] The glass ionomer was cemented on blot-dried, but not desiccated, enamel to facilitate acid ionization and ionic bonding to enamel. No protective varnishes were used, as in restorative applications, since the material area exposed to water of the tooth in the mouth, the skill of the operator, and the handicap of the patient. On the other hand, the main reason for the loss of the glass ionomer sealants could be inadequate adhesion of the cement to the enamel surface, the difficulty to isolate in handicapped patients, or excessive salivation.[4]

CONCLUSION:

Dental caries prevention in handicapped patients is almost uncharted territory in the field of deontology, probably due to the same lack of early attention of these patients. Many times, when they finally make it to the dentist’s office, it is already time to perform more aggressive treatments. However, nowadays, and due to a better spreading of information, parents go earlier with their patients to a dentist’s appointment, which allow us to act in a preemptive instead of a curative manner. Such as brushing, the use of dental floss, and topical fluoride, the dentist has to perform periodic examinations, and implement the use of preemptive non-invasive techniques, such as the topic application of fluoride, and sealants to pits and fissures.

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