Revista Odontológica Mexicana

Facultad de Odontología

Vol. 19, No. 3 • July-September 2015

pp e166–e169

ORIGINAL RESEARCH

Assessment of improved glass ionomer microleakage *(Ketac Molar Easymix®)* with or without use of a conditioner

Valoración de la microfiltración del ionómero de vidrio mejorado (Ketac Molar Easymix®) con o sin el uso de acondicionador

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ABSTRACT

The aim of the present study was to assess microleakage experienced by improved glass ionomer (*Ketac Molar Easymix®*) with and without use of conditioner. In order to conduct this study, 40 third molars were used. Molars had previously been extracted, cleansed and hydrated. Two 20 randomly selected sample groups were established. Samples were subjected to prophylaxis and class V cavities were created on the vestibular (labial) surface of the teeth. Before ionomer application, and according to manufacturer's instructions, group A received a polyacrylic acid conditioner. Whereas group B received direct ionomer application. All samples were subjected to a thermo-cycling process and then were immersed in a 1% methylene blue solution for 30 minutes. All molars were sectioned with carbide burr executing longitudinal cuts at the preparation´s center. Each section was carefully examined under the microscope. Samples were rated and the following was observed: microleakage, for group A was 2.06% and for group B 1.84% which did not represent statistically significant differences. It can therefore be concluded that application of conditioner in this type of cavities and with this particular material does not cause statistically significant differences.

RESUMEN

El objetivo de este estudio fue valorar la microfiltración del ionómero de vidrio mejorado (*Ketac Molar Easymix®*) con o sin el uso de acondicionador. Para lograr éste, se seleccionaron 40 terceros molares extraídos, limpios e hidratados. Se formaron dos grupos de 20 muestras de forma aleatoria, a los cuales se les realizó profilaxis y cavidades de clase V sobre la cara vestibular. Al grupo A se le colocó un acondicionador de ácido poliacrílico como indica el fabricante, antes del ionómero y al grupo B se colocó el ionómero directamente. Las muestras se sometieron a un proceso de termociclado y fueron sumergidas en azul de metileno al 1%, durante 30 minutos. Cada molar fue seccionado con disco de carburo, con cortes longitudinales en el centro de la preparación. Cada sección fue examinada minuciosamente al microscopio. Se calificaron las muestras y se obtuvo que el promedio de microfiltración para el grupo A fue de 2.06% y para el grupo B fue de 1.84%, sin representar diferencias significativas. Por lo que se concluye, con que no existen diferencias significativas en colocar acondicionador en este tipo de cavidades y con este material en particular.

Key words: Glass ionomer, microleakage, conditioner, polyacrylic acid
Palabras clave: Ionómero de vidrio, microfiltración, acondicionador, ácido poliacrílico.

INTRODUCTION

In the last five years, restorative materials have rapidly evolved. This evolution targeted the improvement of the materials' physical characteristics to thus offer better quality in performed treatments. In 1969, Wilson et al successfully developed a new modified cement composed of fine-grained glass silicate ionomer and polyacrylic acid. The first preparation of the aforementioned material was introduced in the market in 1972, with the name of ASPA (aluminum silicate polyacrylic).

In the last 20 years, development of glass ionomer has led to several variables in powder and polycarbonic acid components.[1,2] These differences in composition result in characteristics´ variations. They possess unique properties such as suitable adhesion to enamel and dentin, satisfactory esthetics and long-term fluoride release. Nevertheless, these materials suffer limitations when applied. This is due to their low resistance, fragility and the ease they exhibit to absorb and lose water, thus decreasing their properties. Due to the aforementioned, indications are extremely specific.[2,3]

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In different in vitro studies, microleakage is defined as the passage of bacteria, fluids, chemical substances ions and molecules between the tooth and the restoration.[3-6] This microleakage can occur due to poor adaptation of the restoration to the cavity, as a result of solubility of cement , coatings and bases, or due to significant differences in the expansion coefficient of the restoration material and the tooth. Microleakage can cause many undesirable effects such as hypersensitivity, marginal discoloration, recurrent caries and pulp lesions.[5,7,8]

Due to the fact that glass ionomer cements can physically and chemically adhere to the tooth structure by means of ionic exchange, this material has been used by directly placing it as a restoration to control certain carious processes. This treatment is known as «atraumatic restorative treatment»: it consists on caries removal with exclusive use of manual instruments such as excavators. After this preparation, glass ionomer is directly placed in the preparation.[9,10] Nevertheless, it could be thought that dentin debris covering worn down dental surfaces could disrupt cohesiveness and cause restoration failure during the phase of polymerization contraction.[11]

In former studies it has been reported that adhesion force to tooth surface is inconstant when no previous conditioning treatment has been undertaken, and that clinical retention and adhesion strength can be improved if said layer of dentin debris is removed.[3,18,11]

Ketac Molar Easymix®, the ionomer used in the present study, it embodies several advantages of glass ionomers: it exhibits suitable packing characteristics as well as fluidity properties.[8] It is metal-free, and due to its improved mechanical properties, firm consistency and greater radio-opacity it is an appropriate material to use in permanent teeth to coat underneath resin fillings in class II and III cavities, in the reconstruction of tooth stumps as well as a temporary filling. In primary teeth it can be used to fill class I cavity restorations which do not directly withstand occlusion forces. It can also be used as temporary filling.[2,12]

Ketac Molar Easymix®, as all conventional glass ionomer cements consists on a powder/liquid system and can be acquired in manual-mixing presentation as well as pre-dosed capsules. Powder acidity leads to greater general concentration of acid in the cement. This results in increased cross-reaction and improves mechanical values without dramatically increasing initial viscosity.

In *Ketac Molar Easymix®*, grain distribution and previous glass treatment have been particularly optimized in order to achieve the properties of greater strength and packing consistency, as well as preservation of adhesive characteristics.[2,7,13]

Glass ionomer cements present a high degree of initial fluoride release. This is due to the fact that most released fluoride is kept at the restoration surface. This release continues decreasing for several months to then stabilize to a constant level. *Ketac Molar Easymix®* releases lesser amounts of fluoride than other glass ionomer cements because its solubility is lesser than that of other comparable cements.[7,13]

Even though there are different options in the market of glass ionomer as restoration materials, it is expected that this particular material might offer better characteristics than the rest of materials used in similar procedures.

Materials with very balanced cost-benefit relationship are required in certain procedures and under very specific circumstances. In the case of atraumatic restorations the target would be to preserve the tooth in its position as long as possible until exfoliation.[9,10] The fact of filling the tooth with a unique material that provides necessary characteristics to restore function within the mouth bears the advantages of reducing costs and avoiding lengthy treatments, therefore, it has been considered a suitable option for patients who do not have access to optimal dental treatment without endangering the tooth.[9]

The aim of the present study was to assess whether use of conditioner improves the physical properties of this particular material.

MATERIAL AND METHODS

40 recently extracted molars were selected. These teeth were caries-free and were stored in bi-distilled water to avoid de-hydration. Prophylaxis was conducted on all teeth, and class V cavities were created on the labial (vestibular) surface. These cavities measured 2mm diameter and 5 mm depth. For this endeavor, number 3 round diamond burrs were used in a high-speed hand-piece with irrigation.[14,15]

Samples were randomly divided into two groups:

- Group 1. Samples were filled with *Ketac Molar Easymix®*, using polyacrylic acid as conditioner.
- Group 2. Samples were filled with the same ionomer but without polyacrylic acid use.

Manufacturers' instructions were followed; which were cleansing the surface, removing excess water without totally drying tooth structure.[13] Mixing proportions were one spoonful of powder per one portion of the liquid (two drops). Mixing must be conducted at 20-25 °C temperature. Powder must be mixed with liquid in one sole step. During application

and setting phase, the working field must be protected against excess water and saliva. With environmental temperature of 23 °C and 50% relative air humidity, times to consider are the following: mixing: 30 seconds, preparation 10 seconds, setting 7 minutes.[13]

Both groups of teeth were stored in bi-distilled water within properly labeled containers, during 24 hours at environmental temperature of 37 °C[16]

At a later point teeth were subjected to 500 thermo-cycling cycles for an approximate time of 8 hours 20 minutes. Each cycle lasted for approximately one minute, during which time samples were at a maximum temperature of 50 °C (± 5) during 18 seconds and at a minimum temperature of 5 °C during an additional 18 seconds.[17,18] Once all samples were thermo-cycled, they were placed in containers and arranged once more in the environment chamber for an additional 24 hours. At a later point all samples were coated with nail polish, exposing only the restoration material and exerting great care to seal apexes with wax so as to avoid dye leakage into non-desired areas.

Samples were placed in a 1% methylene blue solution, and were left to stand there for 30 minutes, before being thoroughly rinsed with abundant water. After this, teeth were affixed with self-polymerizing acrylic onto a plastic tablet in order to facilitate handling with the trimmer. All samples were sectioned with diamond burr and irrigation marking the tooth's longitudinal axis and passing through the preparation center, thus dividing the tooth into two equal parts *(Figure 1)*.[19]

Five clinical operators previously standardized in the required type of observation and unrelated to the research observed under the microscope both groups of samples. They were requested to report their perception of microleakage which might be present at the filling-tooth inter-phase to the following scale.

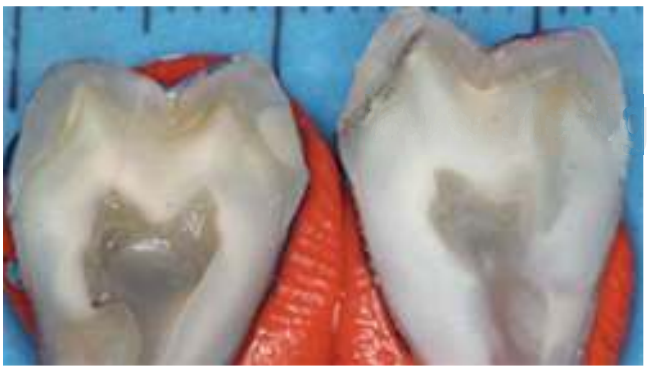

Figure 1. Sectioned samples. Microleakage-free obturation to enamel level can be observed.

- Grade 0. No penetration of dye.
- Grade 1. Penetration only affects half the cavity.
- Grade 2. Penetration affects up to the cavity's bottom.
- Grade 3. Penetration affects all the cavity.

Microleakage degreed of all materials were obtained according to the aforementioned criteria, teeth which presented the same level of micro-leakage in both cases were likewise identified.

One way variance statistical analysis was used for the present study.

RESULTS

Microleakage grade 1 and 2 was observed in six out of the eighty samples examined . In Group I, average microleakage (with polyacrylic acid) was 1.09%. For group II, (without polyacrylic acid) microleakage was 0.92%. These figures do not represent statistically significant differences. One-way variance statistical analysis showed a value of p = 1.000, with 95% reliability. This would further corroborate the fact that there were no significant differences between both groups.

DISCUSSION

Different studies have revealed that there is presence of microleakage in glass ionomer filled restorations independently of whether conditioner was or was not used. Stephen M, in 1995 conducted a study where he compared different conditioners. As control group he used samples that had not received conditioner. He observed greater microleakage in glass ionomer restorations that had received conditioner (polyacrylic acid).[9] In 2001, in concordance with these results, Adreina Castro obtained greater microleakage in glass ionomer preparations previously treated with conditioner, in primary as well as permanent dentitions.[5] Differing from the two aforementioned studies, Yilmaz in 2005 observed greater microleakage in glass ionomer restorations that had not received conditioner.[6]

In the present study it was observed that although a greater amount of samples with microleakage was found in the group where conditioner was used, the difference between both groups was not statistically significant. Nevertheless, it is important to mention that in samples which did not receive conditioner, were observed under the microscope, irregularities in the material´s surface were revealed as well as partial dislodgement of the material in four of the samples.

On the other hand, in samples which had received conditioner, presence of methylene blue circumscribing the cavity was observed as well as some bubbles in the material's body.

CONCLUSIONS

Particularly with *Ketac Molar Easymix®* suitable results were obtained with respect to material´s seal within the preparation, since microleakage was only observed in 1% of all samples. Nevertheless, for the specific aim of the present study, it can be concluded that microleakage is not modified when using or not using a conditioner.

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