

Effect of at Home Dental Bleaching and the Use of Antioxidant on Microleakage of Fissure Sealant : An in Vitro Study

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الخلاصة

الاهداف: تهدف الدراسة الى تقييم التسرب المجهري للحشوات السادة للأخدود، وتأثير استعمال مادة القصر المستعملة في المنزل التي تحتوي على 18% من الكارباميد بيروكسدايد واستعمال مادة الايثانول كمادة مضادة للأكسدة على التسرب المجهري. **المواد وطرائق العمل:** تم استعمال 24 ضرس عقل مقلوع حديثا والخالية من التسوس والصدوع وقسمت إلى ثلاث مجاميع بصورة عشوائية وعملت بمادة القصر المنزلي الحاوي على (18%) كارباميد بيروكسدايد لمدة ساعة يوميا ولمدة (14 يوما)، بعدها تم وضع الحشوات السادة للأخدود وتم تعريض الأسنان لحمام بخاري بين (5-55) درجة مئوية وبتكرار (125) دورة حرارية بدرجات حرارة تراوحت بين (5-55 °م) بعدها تم غمر الأسنان بصبغة ميثيلين الزرقاء (0,2%) لمدة (24) ساعة، ثم وضعت الأسنان في مادة الراتنج ذاتي التصلب، وتم تقطيع الأسنان عموديا وبالاتجاه الخدي الحنكي وتم تحليل مدى احتراق الصبغة للحشوة السادة للأخدود باستعمال مجهر microscope باستعمال مقياس مكون من أربع درجات. **النتائج:** اظهرت النتائج بان التسرب المجهري ازداد بفرق معنوي بين الأسنان التي تم معاملةها بالقصر لمدة (14 يوما) وبين الأسنان التي لم تعامل، وعند استعمال الايثانول لعكس عملية الأكسدة قل التسرب المجهري وبدون فرق معنوي بين المجموع ة التي عوملت بالايثانول بعد القصر والمجموعة التي لم تعامل بالقاصر. **الاستنتاج:** التسرب المجهري ازداد بعد عملية القصر بسبب قلة قوة الرابط بين مينا الأسنان والحشوة السادة للأخدود عند وضع الحشوة السادة للأخدود مباشرة بعد عملية القصر، باستعمال مادة الايثانول أو أي مادة مضادة للأكسدة قلت كمية التسرب المجهري وبفارق معنوي.

ABSTRACT

Aim of the study: To evaluate in vitro the microleakage of fissure sealant, the effect of using home bleaching agent containing 18% carbamide peroxide and the effect of ethanol as an antioxidant agent on microleakage. **Materials and Methods:** Twenty four extracted sound human third molars were randomly assigned to 3 groups. After sealant placement, the teeth were thermocycled (125 cycles; 5-55°C), isolated, immersed in 0.2% methylene blue dye for 24 hours, included in acrylic resin and sectioned longitudinally in a buccolingual direction. The sections were analyzed for leakage using an stereomicroscope, and a 4-criteria ranked scale was used to score dye penetration. **Results:** Microleakage scores increased with significant difference between control and bleached group when home bleach was used for fourteen days, also leakage scores decreased with significant difference when ethanol was used after bleaching to reverse the oxidation process, no significant difference was observed between control versus ethanol group. **Conclusions:** Microleakage scores increased after bleaching because of reduction in enamel bond strength of sealant when the bonding procedure was carried out immediately after bleaching, use of ethanol or other types of antioxidant reduced the amount of microleakage significantly.

Key Words: Home bleach ,microleakage, fissure sealant, antioxidant

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INTRODUCTION

Significant progress has been made in the prevention of dental caries in children and adolescents over the past thirty years. While caries is decreasing on interproximal surfaces, occlusal pit and fissure caries continue to increase.^(1, 2) Pit and fissure sealants are considered an outstanding adjunct to oral health care strategies and fluoride therapy in decreasing occlusal caries onset and/or progression.^(3, 4)

Bleaching of teeth has had a renewed interest since the first 1989 publication of the technique originally called Nightguard vital bleaching.⁽⁵⁾ This technique applies a 10% carbamide peroxide or slightly higher concentrations applied in a custom-fitted tray for a number of days or weeks, preferably using overnight wear. Early reports cite the use on children as young as 10 years of age, primarily for brown fluorosis or genetically yellow permanent teeth.⁽⁶⁾

Many studies have shown a considerable reduction in enamel bond strength of resin composite restorations when the bonding procedure is carried out immediately after bleaching. These studies claim that a certain waiting period is needed prior to the restoration to reach the original bond strength values prior to bleaching.⁽⁷⁾

It is recommended, delays in bonding of 1 to 3 weeks following the bleaching procedure for the enamel to return to the conditions that lead to normal bond. The lower bond strengths of bleached enamel and dentin are a result of the oxidative process caused by the bleaching agents.⁽⁸⁻¹¹⁾ Some authors assert that the oxygen remains in the dental structure after bleaching and can interfere with the polymerization of adhesive monomers.⁽¹¹⁾ Nevertheless, it was observed that the use of anti-oxidant agents before the bonding process can reverse the compromised bonding to bleached enamel.^(11, 12)

The present study was therefore designed to evaluate the effect of at home dental bleaching on microleakage of one type of fissure sealant, and the effect of the use of ethanol as an antioxidant agent.

MATERIALS AND METHODS

Twenty four extracted human third molars free of cracks, caries and restorations were selected, cleaned with periodontal curettes and stored in distilled water with thymol at room temperature. The occlusal surface of the teeth was then polished with non-fluoridated pumice (Qualy Dental, England) with rubber cups (Products Dentaires, Switzerland) at slow speed. The teeth were randomly assigned to 3 groups (n=8). No invasive technique (enameloplasty) was used prior to sealant placement. Conseal fluoride releasing light cured sealant that contains 7% filler particles filled with a submicron filler size of 0.04 microns to withstand surface wear was used in all 3 groups (Helioseal F, Southern Dental Industries). For first group, the sealant material was applied immediately on the occlusal surfaces of the teeth After acid etching with 37% phosphoric acid (Super etch, Southern Dental Industries) for 20 seconds, washed for 5 seconds and dried with oil-free com-

pressed air, sealing material was applied to the pits and fissures along their entire extension with a disposable brush (Southern Dental Industries) and cured for 20 seconds with an LED light curing unit 1800 mW/cm² (Apoza /Taiwan).

For the two other groups, the home bleaching solution that contained 18% carbamide peroxide (Hellerdent Easy & White™) was applied on the occlusal surfaces of the teeth for 60 minutes, then was rinsed thoroughly with water spray, the teeth were kept in distilled water until the next bleaching session. This process was repeated daily for a period of fourteen days consequently (according to the manufacturer instructions). After bleaching, for the second group, the fissure sealant was applied immediately after the last bleaching session according to the manufacture instruction as in the first group, while for the final group, ethanol (Gainland Chemical Company UK), an antioxidant was applied to the occlusal surface for 20 minutes with a cotton pellet immediately after bleaching, the surfaces were kept moist with ethanol and wetted constantly because of the evaporation of ethanol, then they were rinsed with tap water for 30 seconds and then air dried for 20 seconds⁽¹³⁾ then the sealants were applied to the last group.

In preparation for dye penetration test, the root apexes were sealed with acrylic resin, and all the teeth except occlusal surface were coated with two layers of clear nail polish (Turkey).

The teeth were subjected to thermocycling for 125 cycles at temperatures of 5°C ± 2°C and 50°C ± 2°C with a dwell time of 15 seconds.⁽¹⁴⁾ This was followed by the immersion of the teeth in 0.2% methylene blue dye for 24 hours.⁽¹⁵⁾

After removal from the dye solution, they were cleaned and rinsed with tap water. The teeth were embedded in self-curing acrylic resin to prevent chipping of the material and the resin blocks were sectioned with a cut buccolingually and parallel to the long axis, into two fragments using diamond disk for sectioning (Germany). After the above procedures, the length of dye penetration at the sealant/tooth interface was examined under a dissecting microscope with 40 × magni-

fication (Altay, Italy).

The criteria for the amount of dye microleakage was the level of maximum dye penetration. Grading of microleakage was based on the following criteria: ⁽¹⁶⁾
 Grade 0 = No penetration, (Figure 1).

Grade 1 = dye penetration limited to the outer half of the sealant, (Figure 2).

Grade 2 = dye penetration extending to the inner half of the sealant, (Figure 3).

Grade 3= dye penetration extending to the underlying fissure, (Figure 4).



Figure (1): Score 0

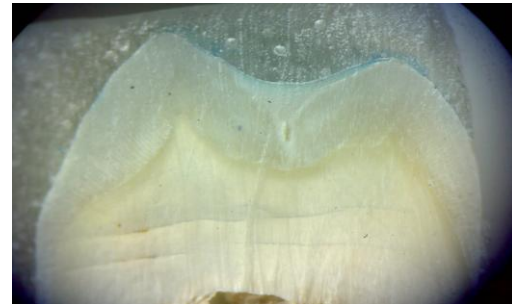


Figure (2): Score 1



Figure (3): Score 2

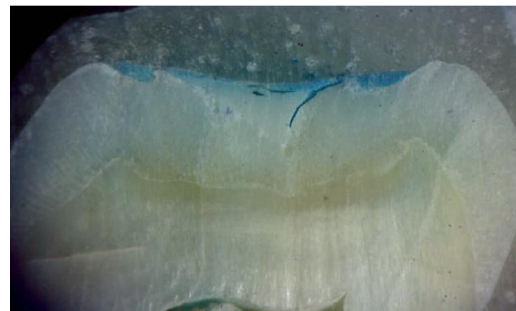


Figure (4): Score 3

The data were analyzed using Kruskal-Wallis, Mann-Whitney U non-parametric tests to compare the groups for statistically significant differences at 0.5% significance level.

RESULTS

No sealant was lost. Microleakage scores are shown in Table (1). Most teeth in the control group did not show dye penetration (score 0), with no tooth scoring (3).

In the bleached group, only one tooth exhibited score zero, and most of the sample showed score 2 (three teeth) and score 3 found in 2 teeth, while in the group that was treated with ethanol prior to fissure sealing the majority of the sample showed score 1.

Table (1): Distribution of Microleakage Scores according to Groups.

| Group | Criteria | Frequency |
|--------------|----------|-----------|
| Control | 0 | 5 |
| | 1 | 2 |
| | 2 | 1 |
| | 3 | 0 |
| Total | | 8 |
| Bleached | 0 | 1 |
| | 1 | 2 |
| | 2 | 3 |
| | 3 | 2 |
| Total | | 8 |
| Ethanol | 0 | 2 |
| | 1 | 5 |
| | 2 | 1 |
| | 3 | 0 |
| Total | | 8 |

It can be observed in Table (2) that there was statistically significant difference in leakage scores for all the three groups with $P < 0.05$, while Table (3) demonstrates leakage scores between each two groups at a time. There was a statisti-

cally significant difference in leakage in the control versus the bleached group, and the bleached versus ethanol group, with no significant difference between control versus ethanol group.

Table (2): Comparison of microleakage scores for the three groups.

| Chi-Square | Degree of Freedom | P-Value |
|------------|-------------------|---------|
| 6.746 | 2 | 0.034 |

Kruskal-Wallis test

Table (3): Comparison of microleakage scores between groups.

| Groups | Z value | P Value |
|---------------------|---------|-----------|
| Control Vs Bleached | 2.302 | 0.02 (S) |
| Bleached Vs Ethanol | 1.831 | 0.05 (S) |
| Control Vs Ethanol | 1.208 | 0.22 (NS) |

Mann-Whitney U test

Figure (5) displays the percentages of the microleakage scores obtained in this study. In control group, 62.5% of the sample showed no leakage, while 25% showed score 1, while score 2 was the maximum score that was found in 12.5%. In the bleached group, score 0 was much reduced (only 12.5%), score 1 was observed in

25%, score 2 was found in majority (37.5%), and score 3 found in 25%. In the ethanol group, there was a slight increase in score 0 compared with bleached group, majority exhibited score 1 (62.5%), while score 3 was found in only 12.5% of the group.

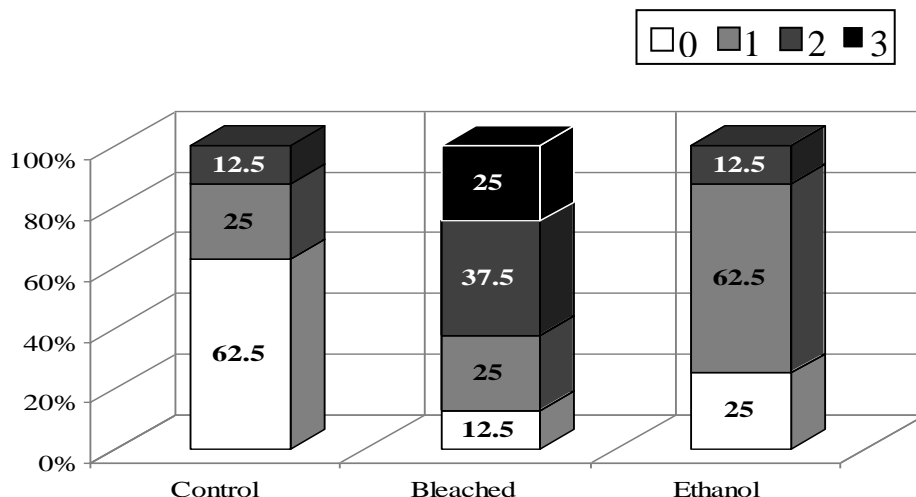


Figure (5): Percentage of microleakage scores.

DISCUSSION

Pit-and-fissure sealants have been considered an outstanding adjunct to oral health care preventive strategies in decreasing occlusal caries onset and/or pro-

gression.⁽¹⁷⁾ The properties of an ideal sealing material include biocompatibility, retention and resistance to abrasion and wear.⁽¹⁸⁾ Sealant bonding to enamel is also important because microleakage at tooth-

material interface can lead to treatment failure.

Microleakage is defined as the passage of bacteria, fluids, molecules, and ions between the teeth and the sealing material.⁽¹⁹⁾ Since this condition may shorten the longevity of any restoration, it should be minimized or preferably eliminated.⁽²⁰⁾

There have been many methods to assess the sealing ability of pit and fissure sealants, the most common approach is the measurement of dye penetration along the interface, In some of these studies methylene blue was employed as tracer to evaluate the degree of infiltration. The small particle size and the permeability of dentinal tubules may lead to overestimate the relevance of this infiltration.⁽²¹⁾ The area of methylene blue is calculated to be around 0.52 nm, smaller than average bacteria. As bacteria have a diameter of 0.3-1.5 μm or larger. This technique cannot distinguish between too narrow and sufficiently wide gaps to allow bacteria passage. An interesting finding was that the use of methylene blue tracer leads to higher leakage scores than other microscope evaluations.⁽²²⁾

The present study showed that exposure of human teeth to at home bleaching material that contained 18% carbamide peroxide for 1hour daily for two weeks produces a significant increase in microleakage of fissure sealant whenever placed immediately after bleaching Tables (1) and (2). The bleached group during microscopic examination showed extensive dye penetration at their seals compared with control group, this result principally from an inability of the sealant material to adhere properly to the etched enamel surface due to decrease in enamel bond. This is in agreement with the results of other studies on composite resins,^(23, 24) that found the bonding strength decreased after use of carbamide peroxide, which may be attributed to weak bonding surfaces that are related to enamel surface morphology with varying degrees of surface roughness and structural changes due to loss of prismatic formation ,another explanation is that the substance and microhardness of the tooth may be affected by the bleaching procedure. Another cause increasing microleakage after bleaching,

may be attributed to the reason that remnants of residual oxygen in the tooth structure may interact with the polymerization of the fissure sealant resulting in poor adaptation and sealing to the tooth structure.⁽²⁵⁾

No previous study has been performed studying the effect of home bleach on fissure sealants to compare results of this study with, home bleach has undergone dramatic improvements since it began to be used.⁽²⁶⁾ By increasing the concentrations of bleaching agents, the time the bleaching trays are kept in the patients mouth has been reduced from full night to less hours.

According to a study on compsite resins,⁽²⁵⁾ residual oxygen, which is released from the bleaching agent as the nascent oxygen and hydroxyl or peri-hydroxyl ions when they were applied to the dental structure, interfered with the resin infiltration into the etched enamel or inhibited the polymerization of resin, the same possibility exist in case of sealant.

Table (3) shows that there was a statistically significant difference in scores leakage. Increased micrleakage scores could be attributed to retained peroxide in the subsurface layer of the enamel possibly resulting in gaseous bubbling from oxidizing reactions that leads to porous formation in the interfaces.⁽¹²⁾

When the teeth were treated with ethanol which is an antioxidant agent after bleaching and before performing the sealing with the fissure sealant there was a reduction in the microleakage scores with a statistically significant difference compared with the bleached group $P \leq 0.05$ (Figure 5), which might be attributed to the reason that the ethanol contained as solvent, may have minimized and/or reversed the inhibitory effect of hydrogen peroxide on resin polymerization, removing residual oxygen by-products thanks to its water-chasing action. A similar mechanism has been described in studies on compromised bonding to bleached enamel.⁽²⁷⁾

The antioxidant role in reversing hydrogen peroxide-related adverse effects on resin bond requires additional research.

CONCLUSIONS

Results showed that applying the sealant immediately after bleaching resulted in a significant difference in increasing microleakage, so if a dental operator is planning to apply fissure sealants to a person using home bleaching products, it is recommended to delay sealant application for a period of 1 to 3 weeks following the bleaching procedure for the enamel to return to the conditions that lead to normal bond or to use an antioxidant agent, as the scores decreased with significant difference when ethanol was used after bleaching and before applying fissure sealants. Other studies are further needed to determine the effect of other types of antioxidant agents such as sodium bicarbonate, sodium ascorbate on microleakage of fissure sealants.

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