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Original Article

Microleakage in different primary tooth restorations

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Abstract

Background: Microleakage may cause tooth sensitivity, secondary caries, discoloration and even failure of the restoration. In order to overcome these potential problems, materials that are able to bind to the tooth structure have been developed, such as composite resin and glass ionomer cement. The purpose of the study was to compare microleakage arising from amalgam (Am), composite resin (CR), glass ionomer (GI), Ketac-Silver (KS), and GI filling with banding (GI+B) when these materials are used for class II restoration of a primary molar.
Methods: Fifty primary molars were collected and class II cavities were prepared on each tooth. The teeth were randomly divided into five groups (Am, CR, GI, KS, and GI+B), each of which received a different material as part of the restoration. The restored teeth then underwent 100 cycles of thermocycling that consisted of 55°C for 30 seconds, 19°C for 20 seconds, and 5°C for 30 seconds. The teeth were then immersed in 0.5% basic fuchsin solution for 24 hours. Afterwards, the teeth were embedded and sectioned mesiodistally through the center of each restoration. Dye penetration associated with the occlusal and cervical margins of each restoration was then assessed.
Results: Cervical leakage was greater than occlusal leakage in the CR, GI and KS groups ($p < 0.05$). When leakage on occlusal margin was examined, however, the Am group showed greater leakage than the CR, GI, and GI+B groups ($p < 0.05$). When leakage on the cervical margin was examined, the Am group showed greater leakage than the GI and GI+B groups, while the KS group showed greater leakage than the GI+B group ($p < 0.05$).
Conclusion: Restorations using GI and GI+B indicated that these materials performed better than the other materials in this study overall. However, none of the materials were entirely devoid of leakage.

Keywords: banding; class II restoration; microleakage; primary molar

1. Introduction

The aim of caries restoration is to prepare the cavity, to remove carious tissue and bacteria, to fill the resulting cavity with an appropriate restorative material, to restore the esthetics of the tooth, to restore chewing functionality, and to prevent the recurrence of caries. Microleakage is the movement of bacteria, liquid, and chemical substances between restoration and tooth.[1] Such leakage will result in the discoloration/staining of the restoration, produce tooth sensitivity, aid in the recurrence of caries, and, finally may lead to failure of the restoration.[2,3] As a result of the above, the amount of microleakage that takes place is an important consideration when selecting a restorative material.

The main cause of microleakage is poor adaptation between the restorative material and the original tooth structure. Another secondary cause is volume change in the restorative material due to cohesive shrinkage during restoration and oral thermal changes after restoration; such volume changes will

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cause a gap to appear between the restorative material and tooth that allows microleakage to occur.[4] The methods available to evaluate microleakage include direct visual examination,[5,6] microscopic examination,[7,8] scanning electron microscopic examination,[9–11] air pressure,[12] dye penetration,[13–16] the use of a chemical tracer,[17,18] the use of radioactive isotope tracer,[19–21] neutron activation analysis,[22] electrochemical methodologies,[23] measuring bacteria penetration,[24] the artificial caries method,[25] and three-dimensional image analysis.[26] Among these methods, using sectioning allows the examiner to see only part of the leakage and not the whole course of leakage. By contrast, using air pressure, neutron activation analysis, an electrochemical methodology, and measuring bacteria penetration does allow the volume of leakage to be measured but does not allow the course of leakage to be determined. Both the dye penetration approach and the chemical tracer method have the merits of easy manipulation, easy analysis of the results and no need for expensive instrumentation. As a result, these approaches are widely accepted as methods when studying the microleakage of dental restorative materials.

In order to overcome the problems of microleakage, some direct bonding materials have been developed including composite resin (CR), glass ionomer (GI) cement and alloy reinforced GI cement. Information regarding microleakage by primary tooth restorations is limited.[27–30] The purpose of the present study was to compare the microleakage of various different restorative materials when they are used to treat class II cavities of primary molar teeth.

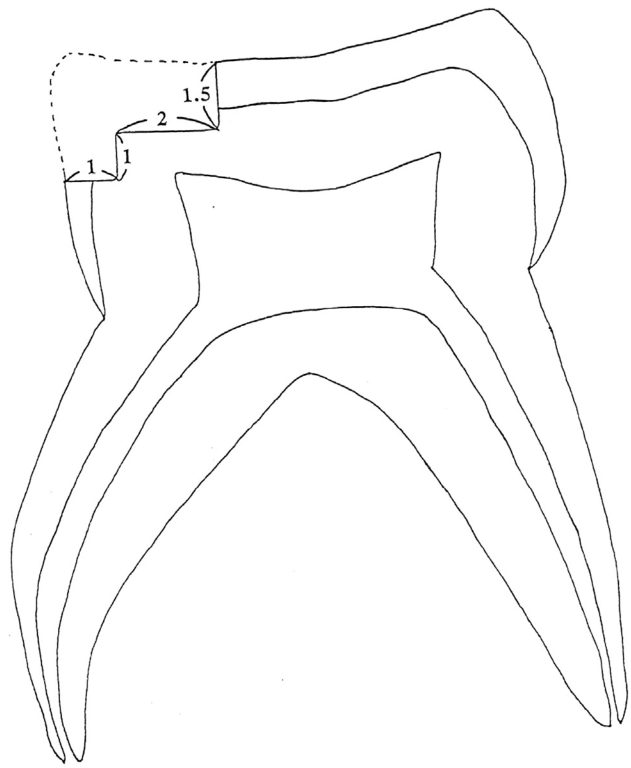

Fig. 1. The dimensions of the cavity preparation: occlusal cavity depth: 1.5 mm, occlusal cavity floor mediodistal width: 2 mm; proximal box mediodistal width: 1 mm, axial wall height: 1 mm. The cervical margin in the proximal box must be on sound enamel. All the cavosurface line angles were butt-jointed and the axiopulpal line angle was rounded.

2. Methods

2.1. Sample selection and cavity preparation

Fifty primary molar teeth were collected at Taipei Veterans General Hospital after the approval of patient's guardians. The teeth used for the study were children's exfoliated primary molars. The collected teeth were cleaned to remove any debris and surrounding soft tissue and they were then stored in normal saline at room temperature. The criteria for tooth selection for this study were that no or minimal caries was present on at least one proximal surface of each tooth. On each tooth a Class II cavity was prepared using a No. 330 carbide bur, and copious water cooling involving one proximal surface that had no or minimal caries. The size of the cavity was buccolingual width: 2 mm; occlusal cavity depth: 1.5 mm, occlusal pulpal floor mediodistal width: 2 mm; proximal box mediodistal width: 1 mm, and axial wall height: 1 mm. (Fig. 1). The cervical margin in the proximal box had to be on enamel. All the cavosurface line angles were butt-jointed while the axiopulpal line angle was rounded. The prepared teeth were randomly divided into five groups with 10 teeth in each group. These groups were amalgam (Am), CR, GI, Ketac-Silver (KS), and GI filling with banding (GI+B), each of which were used to create the filling. The list of materials used is shown in Table 1.

2.2. Restoration procedures

2.2.1. Am group

After the cavity was cleaned and dried by compressed air, two layers of Copalite were applied. Matrix band and the retainer were mounted on the tooth. Am was mixed, filled, and condensed into cavity following the manufacturer's instructions. The occlusal morphology of the restoration was burnished and the restored teeth were stored in normal saline for 24 hours. Finally, the teeth were polished and then returned to normal saline for storage.

2.2.2. CR group

After the cavity had been cleaned with water and dried with compressed air, the cavity was etched with 37% phosphoric acid gel for 60 seconds followed by rinsing with water for 30 seconds. After etching, the cavity was dried with compressed air for 15 seconds, and then a bonding agent (Scotchprep dentin primer) was applied onto the dentin for 60 seconds. The bonding agent was dried by compressed air for 15 seconds, then a bonding agent (Scotchbond 2 light-curing dental adhesive) was applied to the whole cavity. The cavity with bonding agent was light-cured for 20 seconds. A translucent matrix band and retainer were mounted on the tooth. CR was introduced and cured using the incremental method (Fig. 2). The cured restoration was finished and polished 15 minutes later. A layer of dentin bonding agent