AN IN VITRO ASSESSMENT OF THE MARGINAL LEAKAGE OF COMPOMER, AMALGAM AND BONDED AMALGAM RESTORATION

Salah Eldin Mostafa Elbeher;1 Naguib Mahmoud Mostafa Aboul-Enein;2 Mohamed Sherif Mohamed Salah Eldin Hassan Farag3 and Wael Mahmoud Abd-El-Khalek4

1. Professor of Pediatric Dentistry Faculty of Oral and Dental Medicine, Cairo University.
2. Professor of Endodontic, Faculty of Dentistry, Suez Canal University.
3. Assistant Professor of Pediatric Dentistry, Faculty of Dentistry, Suez Canal University.
4. Assistant lecturer of Pediatric Dentistry, Faculty of Dentistry, Suez Canal University.

ABSTRACT

This study was conducted to evaluate the micro-leakage of amalgam, bonded amalgam and compomer in vitro by examination of thirty restored bovine teeth. The microleakage evaluation showed no difference between amalgam and compomer while there was less leakage of bonded amalgam than other restorative materials (depth of dye penetration).

INTRODUCTION

Dental caries continues to be a major problem in dentistry and should receive significant attention in every day practice. Removal of dental caries and restoration of the tooth should be done as early as possible to avoid extensive tooth destruction and subsequent pulp involvement. The ideal goal of restorative dentistry in primary teeth is to maintain space length, preserve masticatory function, and prevent infection and chronic inflammation in the oral cavity. (1)

Over the past 50 years, many changes have occurred in the development and availability of restorative materials for children. For the posterior teeth, the practitioner was limited to amalgam, stainless-steel crowns, or possibly steel orthodontic bands retained with luting cement, which were also used as a restoration. (2,3)

Dental amalgam is widely used as a restorative material even though it is not esthetic and there has been extensive anti-amalgam rhetoric. Although other materials have been improved greatly, amalgam has the proven safety record and the best cost-to-benefit ratio. Clinical evidence indicates that, in the posterior permanent dentition where esthetics is not a primary concern, the small, minimally prepared, amalgam restoration, with its margins and any caries-susceptible fissures sealed with resin fissure sealant, is the restoration with the best survival. Amalgam also remains the best direct restorative option when larger restorations are required. (4,5)

The development of adhesive restorative materials has led to more conservative cavity design with greater reliance being placed upon the bond of a material with tooth tissue for retention of the restoration. Glass-ionomer cements may offer particular advantages but have yet to achieve the durability reported for amalgam. (3,6)

A variety of alternatives to amalgam are now available for use in class II restorations in primary teeth,
including glass ionomer, composites, and resin modified glass ionomers (RMGI) and intermediate materials such as compomer. Today, the pediatric dental practitioner is confronted with many materials from which to select for each restorative situation. The number of choices, while allowing more control of the final result, also creates confusion in terms of how to distinguish the uses of these various materials. (7)

In this study we made an invitro assessment of the marginal leakage of Compomer (Dyract), Amalgam and bonded Amalgam restorations.

**MATERIALS AND METHOD**

Thirty fresh, caries free bovine incisors were selected for this study. The teeth were debrided and stored in water at room temperature for one week. Class V cavity preparations were cut on the facial surface with straight carbide fissure burs at high speed with air / water coolant. Circle preparations centered in the middle third were approximately 1.5 mm deep, and 3.0 mm in diameter. A pattern was stamped onto the buccal surface and a mark was made on the bur to ensure uniform cavity preparations, Fig. (1). (8)

The restorative materials: Compomar(Dyract)*, Amalgam (DSI)** and Amalgam (DSI) with Scotchbond Multi-purpose plus***, were randomly assigned to an equal number of preparations (Fig. 2). Each material was placed according to manufacturer's instruction. The restored teeth were stored in water at room temperature for one week, and during this time they received 2000 thermal cycles between 5°C and 55°C water baths. Dwell time was one minute, with a 10-second transit time between baths. (9) After thermocycling, the apices of the teeth were sealed with sticky wax, and all tooth surfaces, except a one mm wide zone around the margins of each restoration sealed with nail polish, Fig. (2). The teeth were immersed in water as soon as the nail polish dried to minimize dehydration of the restorations. The teeth were immersed for 4 hours in 10% solution of methylene blue dye, rinsed with water, dried with air and invested in clear resin, Fig. (4). (9)

The thirty invested teeth, were sectioned longitudinally through the center of the restorations with a slow-speed water-cooled diamond disc, Fig. (5). This produced 60 sections of restorations. For each restoration section, both the incisal and gingival margins were evaluated. These were visually examined for dye penetration along cavity walls by use of a binocular microscope at a magnification of X 20.

---

* (Dyract Dentsply-DeTrey, GmbH, Germany).
** (Southern Dental Industries, Victoria, Australia).
*** (3M, Dental Product, and St. Paul, Minn.).

---

Fig (1): A photograph showing a bovine tooth with circle cavity preparation.

**FIG. (2) A photograph showing bovine teeth after restoration**
The extent of leakage were evaluated and recorded according to the depth of dye penetration with the following scores (6):

0. No penetration.
1. Penetration not deeper than half of the length of the cavity walls between margin and cavity floor.
2. Penetration deeper than half of the length of the cavity walls between margin and cavity floor.

The worst score of each tooth (two sections) were registered.

The results obtained were tabulated and analyzed for statistical difference between the groups.

**RESULTS**

The results of this study in table 1 and 2 show descriptive data of the studied groups regarding microleakage scores. From these tables, it was found that the Amalgam group showed less microleakage than Compomer (Dyract) group. When the bonding material was used, it was found that, microleakage decreased markedly. This change was significantly different when compared to Dyract and amalgam groups. Figures (6&7) show the extant of microleakage (depth of dye penetration).

**FIG. (6)** A photomicrograph showing longitudinally sectioned bovine tooth with Dyract restoration. Dye penetration more than half of the length of the cavity walls between margin and cavity floor. (Score 2).
Discussion

Silver Amalgam had been used for restoring teeth for over 150 years and it is still used extensively in pediatric dentistry. From the prominent disadvantages of amalgam restorations are lack of adhesion to tooth structure and lack of esthetics. Increasing demand for more esthetic restorations and public concern over the harmful effects of mercury on health and the environment have fueled a search for acceptable alternatives to Amalgam. (10)

The present study investigated an in vitro assessment of the marginal leakage of the Compomar (Dyract), Amalgam (DSI) and Amalgam (DSI) with Scotchbond Multi-purpose plus.

Bovine teeth were selected for this study, because they are considered comparable for human teeth in laboratory studies. Circle preparations were centered on the middle third to avoid the crakes which may be occurred by the forceps during extraction. The restored teeth were stored in water at room temperature for one week, and during which time they received 2000 thermal cycles between 5°C and 55°C water baths. This thermocycling occurred to subject the materials to thermal changes similar to the oral environment. The results of the present investigation showed that, the Amalgam group showed less leakage than Dyract (Compomer) group. These result

| TABLE (1) Comparison between studied bovine groups regarding microleakage score |
|-------------------------------------------------|----------------|----------------|----------------|
| score   | Dyract (10) | Amalgam (10) | B.Amalgam (10) |
| no (%)  | no (%)       | no (%)        | no (%)         |
| 0       | 0 0.00      | 0 0.00        | 5 50.00        |
| 1       | 7 70.00     | 4 40.00       | 3 30.00        |
| 2       | 3 30.00     | 6 60.00       | 2 20.00        |

| TABLE (2) Comparison between studied bovine groups regarding microleakage score |
|-------------------------------------------------|----------------|----------------|
| groups | mean±SD | Statistical test & p value |
| Dyract(10) | 1.3±0.48 | Kruskal wallis = 1.7 |
| Amalgam(10) | 1.6±0.52 | |
| A. Bond (10) | 0.7±0.82 | |

* P= significant  P<0.01*

![FIG (7) A photomicrograph showing longitudinally sectioned bovine tooth with Amalgam restoration. Dye penetration less than half of the length of the cavity walls between margin and cavity floor (score 1).](image)

**DISCUSSION**

Silver Amalgam had been used for restoring teeth for over 150 years and it is still used extensively in pediatric dentistry. From the prominent disadvantages of amalgam restorations are lack of adhesion to tooth structure and lack of esthetics. Increasing demand for more esthetic restorations and public concern over the harmful effects of mercury on health and the environment have fueled a search for acceptable alternatives to Amalgam. (10)

The present study investigated an in vitro assessment of the marginal leakage of the Compomar (Dyract), Amalgam (DSI) and Amalgam (DSI) with Scotchbond Multi-purpose plus.

Bovine teeth were selected for this study, because they are considered comparable for human teeth in laboratory studies. Circle preparations were centered on the middle third to avoid the crakes which may be occurred by the forceps during extraction. The restored teeth were stored in water at room temperature for one week, and during which time they received 2000 thermal cycles between 5°C and 55°C water baths. This thermocycling occurred to subject the materials to thermal changes similar to the oral environment. The results of the present investigation showed that, the Amalgam group showed less leakage than Dyract (Compomer) group. These result
is comparable with the results of Ferrai et al in 1998 and Marks et al in 2000. On the other hand, the results are opposed by that of Duggal et al in 2002. who found that, significantly and better marginal integrity for Dyract (Compomer) compared with Amalgam. When the bonding material was used, microleakage was found to decrease markedly. This change was significantly different when compared to Dyract (Compomer) and Amalgam groups. This results was in accordance with results of Cannon et al in 1999, Neme et al in 2000, William et al in 2000, and Muniz et al in 2005. It was found that; statistically significant increase in bond strength and a statistically significant decrease in extent of microleakage.

REFERENCES