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ORIGINAL ARTICLE

Microleakage in contemporary esthetic restorations following cyclic wet-dry storage

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KEYWORDS

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Abstract *Objective:* To compare the incidence of microleakage associated with contemporary esthetic restorative-adhesive systems following cyclic wet and dry storage as a representation to the dry mouth condition. *Methods:* Standardized cervical cavities in both buccal and lingual surfaces of 100 extracted human premolars were restored in 10 groups ($n = 10$ with 20 cavities) using 7 contemporary esthetic restoratives and 3 adhesive systems following their manufacturers' instructions. Cavities in groups 1–3 were restored with self-adhesive restoratives; conventional glass-ionomer (GI) (Ketac Molar Aplicap), resin modified glass-ionomer (RMGI) (Vitremer) and self-adhesive flowable composite (SAFC) (Fusio Liquid Dentin). Conventional flowable (FC) (Filtek Z350 Flow), nano-hybrid (HC) (Filtek Z250 XT) and nano-filled (NC) (Filtek Z350 XT) methacrylate-based composites were used in conjunction with total-etch, 2-step adhesive (Adper Single Bond 2) to restore cavities in groups 4–6. The same restoratives were also used to restore cavities in groups 8–10 in the presence of self-etch, 1-step adhesive (Adper Easy One), while cavities in group 7 were restored with silorane-based composite (Filtek P90) together with its specific adhesive system. Five restored teeth from each group (10 cavities) were subjected to cyclic storage in wet and dry environment, each for 12 h/day and for a total period of 30 days, while the other 5 were tested with no cyclic storage to serve as control. Using dye penetration technique, the associated microleakage was then scored from 0 to 4 for all restorations according to the depth of dye penetration at both occlusal and gingival interfaces. The incidences of each score were recorded in percentages and the numerical microleakage data were statistically analyzed using Kruskal–Wallis and Mann–Whitney comparisons at $\alpha = 0.05$ to stand on the significance of differences detected between groups. *Results:* All restorative systems showed incidences of microleakage before and following cyclic storage in wet and dry environment with no specific manner declared for any. Statistical analysis of the scored data revealed no difference between different restorative systems under no storage condition, however HC, S and FC in groups 5, 7 and 8 showed higher rates of

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microleakage when subjected to cyclic wet-dry storage (Mann–Whitney, $P < 0.05$). No significant effect of storage was declared on any of the tested restorative systems (Kruskal–Wallis, $P > 0.05$). For each restorative system, no significant difference (Kruskal–Wallis, $P > 0.05$) was recorded between microleakage values recorded at occlusal and gingival interfaces. *Conclusion:* Occlusal and gingival sealing ability of flowable resin composite bonded with self-etch, 1-step adhesive is the most affected following cyclic wet-dry storage. Selection of such restorative option accordingly is not suggested for patients suffering from dry mouth.

1. Introduction

Many types of esthetic restoratives have achieved clinical acceptance throughout the few last decades. These materials have the ability to achieve restorations with respectable clinical and esthetics performance.[1–4] Recent improvement in materials' science and technology led to the development of contemporary modified restoratives and adhesives with excellent sealing abilities. Resin modification of glass-ionomer (GI) restorative offset many drawbacks of that self-adhesive material.[5] On the other hand, the simplified application of the lightly-filled flowable resin composites,[5,6] was encouraging to introduce its self-adhesive version.[7,8] In addition, considering nano-fillers and silorane resin technologies in composite formulations helped produce minimally-shrink restoratives with acceptable physical properties.[3–5,9–11]

Several clinical and laboratory studies[3,4,7,8,10,11] revealed an acceptable performance of the self-adhesive and minimally-shrink restoratives, although their success is referred to many factors including quality bonding to tooth structure. The desired bonding quality is usually achieved when laboratory tests indicate acceptable bond strength and resistance to microleakage at tooth-restorative interfaces.[10] Current total-etch and self-etch adhesive systems usually show acceptable bonding and microleakage resitance.[5,12–18] Low rates of microleakage was also observed in silorane-based composite restorations when its specific self-etch adhesive system was used in company following the manufacturer's recommendation.[19]

Certain medical conditions such as Sjogren's syndrome, AIDS, Stroke and Alzheimer's together with antidepressant and irradiation therapies are manifested with signs of dry mouths. Moreover, mouth breathers, in response to continuous in and out air streams, also suffer of intermittent periods of dry mouths. This situation may result in dryness and in some instances contraction of intra-oral tissues including dental restorations. Dryness of such restoration could, in turn, enhance their degradation and solubility. In addition, stresses may develop at restoration-tooth interfaces as a result of exchanging wet and dry situations. Those cumulative conditions may weaken the restorative-tooth bond and accordingly contribute to the process of microleakage.[20–22]

The possibility of fluid sorption and subsequent solubility in contemporary esthetic restoratives and adhesives have previously been proved, however the adverse effects of fluid uptake or/and dry out on materials' dimensions and bonding have not been declared.[9,23–26] In response, the current *in vitro* study concerned to compare the incidence of microleakage, as an indicator of bonding quality, in different cervical esthetic restorations following swaps of wet and dry storage in representation of the dry mouth condition.

2. Materials and methods

One Hundred caries-free premolars were selected out of those extracted for orthodontic purpose. All teeth were ultrasonically cleaned (Pro-Sonic 300 MTH, Sultan Chemists Inc, Englewood, NJ) to remove all surface deposits. Each tooth then received two standardized truncated-shaped cervical cavities (3 mm in outer diameter, 1.5 mm in inner diameter and 1.5 mm deep) on its buccal and lingual surfaces. Number 001/018 round burs (DIA-BURS BR31, Mani Inc., Tochigi, Japan) were used to start those cavities at the enamel-cementum junction. The preparation continued using double truncated cone diamond tips (#039/032 DIA-BURS EX11, Mani Inc., Tochigi, Japan) till a standardized depth is achieved. The drilling depth was adjusted to the full height of the terminal cone of the diamond tip (Fig. 1). The use of the selected tips helped produce cavities with flat axial walls, outward diverged side walls, and cavo-surface margins with no bevels (Fig. 1). All teeth were then classified into 10 test groups (10 teeth with 20 cavities each) according to the restorative-adhesive combination used to restore the previously prepared cavities. The details of materials used and the distribution of test groups are shown in Tables 1 and 2.

Cavities in groups 1–3 were directly restored with self-adhesive restoratives, conventional glass-ionomer (GI), resin-modified glass-ionomer (RMGI), and self-adhesive flowable composite (SAFC), with no adhesive used. GI restorations were protected for 24 h with a coat of resin adhesive (Adper Single Bond 2, 3M ESPE, St. Paul, MN) that was exposed for 10 s to LED curing light having intensity of 1200 mW/cm^2 and wave length of 430–480 nm (Elipar S10, 3M ESPE AG, Seefeld, Germany) before their finishing. Cavities in groups 4–6, were filled with methacrylate-based flowable (FC), nano-hybrid (HC) and nano-filled (NF) resin composite restoratives respectively. All these restoratives were bonded into the prepared cavities using total-etch, 2-step adhesive system (Adper Single Bond 2, 3M ESPE, St. Paul, MN). The silorane-based composite restorative (S) (Filtek P90, 3M ESPE, St. Paul, MN) in group 7 was bonded to the surfaces of group 7 cavities using its specific self-etching, 2-step bonding system (P90 system adhesive, 3M ESPE, St. Paul, MN). Cavities in groups 8–10 were respectively restored with the same previously used methacrylate-based resin composites (FC, HC and NF). Composite restoratives in those groups were bonded into cavities using self-etch, 1-step adhesive system (Adper Easy One, 3M ESPE, St. Paul, MN). All