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ORIGINAL ARTICLE

# Microleakage evaluation in restorations using different resin composite insertion techniques and liners in preparations with high c-factor – An in vitro study

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**KEYWORDS**

Microleakage;
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C factor;
Enamel;
Cementum

**Abstract** *Objective:* To evaluate microleakage in the enamel and cementum walls in preparations with high C factor, using three resin composite insertion techniques and two liners.
*Materials & methods:* Standard class V cavities were prepared in buccal and lingual aspects of 36 caries free, extracted premolars. The teeth were randomly assigned to three groups of 12 each corresponding to three different insertion techniques (1) Oblique insertion (2) Horizontal insertion and (3) Bulk insertion and then subdivided into three groups of four each depending on the type of liner used (1) no liner (2) RMGIC liner (GC fuji II LC) and (3) Flowable composite liner (Tetric flow, Ivoclar vivadent). The preparations were etched and restored with an Adhesive (adper single bond 2 3M ESPE), Liner (except for the no liner group) and Microhybrid resin composite (Z100, 3M ESPE). Specimens were isolated with nail varnish except for 2 mm wide rim around the restoration, thermocycled (1000 thermal cycles, 5/55 °C, 30 s dwell time) and then immersed in an aqueous solution of 50 wt% silver nitrate for 24 h followed by 8 h in a photo developing solution and evaluated for microleakage using a stereomicroscope on an ordinal scale of 0–4. The microleakage scores were analyzed by using the chi square test.
*Results:* Oblique incremental technique coupled with the use of flowable composite liner gave better results when compared to other groups at the cementum margins.

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*Conclusion:* None of the insertion techniques nor the use of liners were able to eliminate microleakage completely; however the use of the oblique insertion technique coupled with the use of flowable composite liner gave better results.



## 1. Introduction

Although resin composites are the most commonly used direct tooth colored restorative material, polymerization shrinkage still continues to be a problem.[1–3] This can result in impaired marginal seal providing access to bacteria, oral fluids, molecules and ions at the preparation walls/restorative material interface.[4,5] This in turn leads to staining at the margins of the restorations, a hastening of the breakdown at the margins of the restoration, recurrent caries at the tooth preparation walls and restorative material interface, hypersensitivity of the restored teeth and development of pulpal pathology[6] all of which endanger the longevity of the restoration.[7]

Numerous studies support the contention that many of the irritant properties, previously associated with chemical action of filling materials are themselves infact related to bacterial leakage.[6,8–10] Although little or no clinical evidence sustains the hypothesis that composite materials with greater polymerization shrinkage have poorer clinical performance, laboratory data from several studies support this belief.[1,3,11,12]

The factors ascribed to marginal microleakage are the adhesive bond strengths to different dental substrates[4,13,14] which in turn depend on the histological and morphological characteristics of the enamel, dentin/cementum,[15] residual stress created by resin composite shrinkage,[16,17] differences among enamel/dentin and restorative materials coefficient of thermal expansion, polymerization source variables, cavity location and C-factor, resin composite insertion techniques all of which aggravate several clinical variables.[18]

In 1987, Feilzer et al. postulated that the geometric configuration of the cavity plays an important role in the adaptation of resin composite restorations.[19] Since then several techniques have been suggested to improve marginal adaptation of high C factor preparations that potentially resists composite shrinkage[2,16,17,20,21] like soft curing,[1,3,11,12,22] incremental technique,[11,19,24] sandwich technique,[25,26] use of an intermediate low modulus liner,[12,29–31] different cavity preparations,[27–30] use of beta-quartz glass ceramic inserts,[32] use of pre-polymerized composites inserts,[32] use of self-cure resin as the first increment[33] using the protocols for photo-polymerization[34] increasing the filler content, increasing the molecular weight per reactive group and use of ring opening monomers.[1,35]

Considering the resin composite placement methods, some studies have shown that the incremental technique especially the oblique technique tends to improve marginal adaptation by resisting resin composite shrinkage stress.[23,29] On the contrary other reports demonstrated that the bulk placement of composite induces less contraction stress, minimizing marginal leakage.[36] The use of an intermediate low modulus liner between the margins of tooth preparation and restoration has been advocated by some to provide a homogenous distribution of stress over the adhesive interface.

The objectives of this study were to evaluate microleakage in the enamel and cementum margins in high C factor preparations when resin composite is placed by three different insertion techniques and also to judge the effects of liners on microleakage.

## 2. Materials and methods

Thirty-six caries free premolars were selected after examination under a stereomicroscope at 10× magnification to detect any enamel cracks or fissures, which could cause errors during microleakage evaluation. The teeth were then stored in an aqueous solution of 0.5% Chloramine at 4 °C.

Standard high C factor class V cavities were prepared both on the buccal and lingual surfaces of each of the 36 teeth, for a total of 72 cavities. The gingival cavosurface margin of the preparation was deliberately kept below the cementoenamel junction. The preparations were made with a No. 245 carbide bur (SS White) in a high speed standardized handpiece under copious water coolant. After every five preparations the bur was discarded and replaced with a new one.

The final preparation had the following extensions: 3.0 mm Occlusogingivally, 3.0 mm Mesiodistally and 1.5 mm deep. The preparations were re-evaluated at 10× magnification to ensure the absence of pulp exposure and enamel cracks at the cavosurface margins.

These 36 teeth were then randomly divided into three groups of 12 each corresponding to three different insertion techniques Bulk, Horizontal and Oblique and then further divided into three subgroups of four each depending on the type of Liner used (No liner, Resin modified glass ionomer cement (RMGIC) liner and Flowable composite liner).

The preparations were etched with 35% phosphoric acid (Scotch bond Etchant, 3 M ESPE) for 15 s, rinsed with water for 15 s and blot dried, leaving the dentin moist and shiny. An ethanol and water based adhesive system (ADPER single bond 2, 3M ESPE) was applied in two consecutive coats to the entire preparation according to the manufacturer's instructions, gently air dried to dispense the solvent and light cured for 20 s (LED Gnatus). All the experimental groups were restored with a microhybrid resin composite (Z100, 3M ESPE) shade A2. Each increment in all experimental groups was light cured for 40 s at a curing distance of 0.5 mm and light intensity of 550 mw/cm$^2$, which was constantly monitored.

**Group I (Bulk technique):** Bulk insertion technique group ($n$ = 12). This group was further sub divided into three subgroups of four each according to the type of liner/no liner used:

- **Sub-group A:** No liner used ($n$ = 4), teeth in this group were restored with microhybrid resin composite (single increment).