

## Microleakage evaluation of four tooth colored restorative systems

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تقسيم التسرب المجهري لأربعة أنظمة من المواد المستخدمة كحشوات تجميلية  
 تحول الحواف، أيونات، إزيمات ومتحالفهم خلال الفجوات التي بين منطقة الظاء سطح السن مع الحشوة بعزف بالتسرب المجهري. هذه الظاهرة تُرْتَبَا تؤدي إلى تغير اللون على  
 حدود الحفرة السنية، حدوث التسوس مرة أخرى أو حدوث التهابات لب السن. حساسية الأسنان بعد علاجها ربما كانت أيضا كنتيجة للتسرب المجهري. الهدف من هذه  
 الدراسة: هو تقييم مقدرة أربعة أنظمة من المواد المستخدمة للحشوات التجميلية على منع التسرب المجهري.  
 المواد: كونكويسنت كريستال / بوندون، فلوريسنتور / تاتيبور كويك بالفلوريد، كومبوجلاس / سينتاك و كيتاك مولر أبلي كاب. الطريقة: تم تحضير 40 ضاحكة مقلوحة حديثا  
 وذلك بعمل حشوة من الصنف الخامس (صنف V حسب تصنيف بلاك) في منطقة الظاء مع الملاط (السطح 3 ملليمتر، عمق 1.5 ملليمتر  
 ). بعد التحضير تم توزيع 10 عينات عشوائية لكل مادة من المواد المستخدمة. بعد إتمام عملية الحشو للحفر حسب إرشادات الشركات المصنعة تم تقويم العينات في حوض مائي  
 بدرجة حرارة 37 درجة مئوية لمدة 72 ساعة. تم تعريض العينات لـ 500 دورة حرارية على درجة حرارة ما بين 5 إلى 55 درجة مئوية لمدة دقيقة واحدة لكل دورة بعد ذلك  
 استخدمت المصبغة الكاشفة من نوع بيسك فيوشين 0.2% للكشف عن التسرب المجهري. النتائج: لم يظهر أي تسرب مجهري على حدود سطح  
 المينا في مجموعتين من المواد المستخدمة (كومبوجلاس / سينتاك و كيتاك مولر أبلي كاب) أما على حدود سطح الملاط فكان التسرب ظاهري في جميع المجموعات من المواد  
 المستخدمة. النتيجة: لم يستطع أي نظام من الأنظمة المستخدمة على منع التسرب من حدود سطح الملاط بشكل كامل ولكن هذه الأنظمة لديها القدرة على التقليل من التسرب  
 المجهري على حدود سطح المينا.

This study evaluated microleakage of four tooth colored restorative systems. Conquest Crystal/Bond 1, FloRestore/Tenure Quick with fluoride, Compoglass/Syntac and Ketac - Molar Aplicap which are: a composite resin, a flowable composite, a compomer and a glass ionomer cement respectively.

Class V-like circular preparations (3 mm diameter, 1.5 mm deep) were prepared at the cemento-enamel junction of 40 extracted human premolar teeth. Ten cavities in each group were restored with one of the materials. Following 72 hours storage in a 37°C water bath, the restored teeth were thermocycled for 500 cycles between 5°C and 55°C for one minute in each cycle. Microleakage was assessed by dye penetration using 0.2% basic fuchsin dye. The results were analyzed using the Kruskal-Wallis Test. No microleakage was evident at the enamel margins as well as in the gingival margins. None of the systems evaluated were able to prevent microleakage at the gingival margin (cementum) completely, but these systems were effective in minimizing microleakage at the enamel restorative interface.

### Introduction

The ingress of acids, ions, enzymes and their products through gaps at the tooth restorative interface has been termed microleakage.<sup>1</sup> This phenomenon may predispose a tooth to discoloration at cavity margins, recurrent decay and pulpal inflammation.<sup>2,3</sup> Post-operative sensitivity has also been reported as a result of microleakage.<sup>4,5</sup> One reason suggested for microleakage is the formation of a gap at the tooth-restoration interface by the polymerization shrinkage of a composite resin.<sup>4,6-8</sup>

Since the introduction of composite materials in dentistry, continual improvement has been made in their properties. Microleakage, however, still occupies a major focus of researchers trying to

improve the longevity of composite restorations.<sup>9,10,2</sup> Manufacturers have developed bonding agents in an attempt to control leakage at the tooth-restoration interface. The acid-etching technique has reduced microleakage at the enamel-composite interface.<sup>9-11</sup> In spite of the introduction of a number of dentin bonding agents, microleakage is still often reported, where the cavosurface margin is placed on dentin or cementum.<sup>8,12-15</sup>

The purpose of this *in vitro* study was to evaluate microleakage associated with four commercially available tooth colored restorative systems.

### Materials and Methods

Forty non-carious extracted human premolar teeth were used in this experiment. The teeth were stored in 0.1% thymol solution at room

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temperature after their extraction. The teeth were cleaned by removing any remaining soft tissue and stored in a physiological saline solution until use. To effectively eliminate microleakage at the root apices, the following procedures were performed. The apices of the roots were removed with a separating disc. Class I preparations were made at the cut apical root surfaces with an inverted cone carbide bur. Two coats of Copal cavity varnish were applied to these preparations and the specimens were restored with Dispersalloy amalgam (Caulk/Dentsply, Milford, DE).

Immediately prior to the cavity preparation, the tooth surfaces were cleaned with pumice and water using a rubber cup in a slow speed handpiece. A Class V-like circular cavity preparation was placed on the buccal surface of each tooth with a No. 330 bur.

The preparations were located at the cemento-enamel junction. Approximately fifty percent of the cavity margins were placed in enamel and the other 50% were placed in the cementum. The preparation was approximately 3 mm in diameter and 1.5 mm deep.

Ten teeth were randomly selected for each restorative system. The following systems were used in accordance with manufacturer's directions: Conquest Crystal/ Bond 1 (Jeneric/Pentron Inc. Walligford, CT.), FloRestore/Tenure Quick with fluoride (DenMat, Inc. Santa Maria, CA.), Compoglass/Syntac (Ivoclar North America, Inc. Amherst, NY) and Ketac-Molar Aplicap (ESPE America, Norristown, PA). These systems are, respectively: a composite resin, a flowable composite, a compomer and a glass ionomer cement. Following placement and finishing, all specimens were stored in distilled water at 37°C for 72 hours. The teeth in each group were thermocycled for 500 cycles between water baths of 5°C and 55°C. Immersion time was approximately 30 seconds in each bath. Following thermocycling, the entire tooth was coated with a nail polish with the exception of the restoration and approximately 1 mm around it.

The restorations were evaluated for marginal microleakage by immersion in 0.2% basic Fuchsin dye (Fisher Scientific, Fairlawn, NJ) for 24 hours. Following removal from the solution, the teeth were rinsed with tap water. Each tooth was mounted in cold cure acrylic resin using a plastic mold. The restored area was protected by a sticky wax followed by clear nail polish to avoid dye dissolution during the mounting procedure. Each tooth was sectioned longitudinally through the

center of the restoration with a diamond blade (Isomet, low speed saw, Buehler Ltd. Evanston, IL). The specimens were examined under a microscope at 25X magnification by 2 different examiners. The specimens were scored according to the following criteria:

0 = no dye penetration

1 = the dye penetrated less than or up to one half of the cavity depth

2 = the dye penetrated more than one half of the cavity depth but not extending to the axial wall

3 = the dye penetrated to involve the axial wall

Each specimen produced two segments after sectioning, both of which were evaluated and the higher score was included in the results. No difference in scoring was detected among the two examiners.

## Results

The average microleakage scores at the enamel margins are listed in Table 1. No microleakage was evident at the enamel margins of Ketac-Molar Aplicap restorations and 9 of the Compoglass restorations. Nearly half of the Conquest Crystal and FloRestore restorations showed leakage.

Table 1. Enamel margins microleakage scores. (n = 10)

Materials	Scores			
	0	1	2	3
Conquest Crystal/Bond 1	4	6	0	0
FloRestore/Tenure Quick	6	4	0	0
Compoglass/Syntac	9	1	0	0
Ketac-Molar Aplicap	10	0	0	0

The average microleakage scores at the dentin/cementum margins are shown in Table 2.

Table 2. Gingival margins microleakage scores. (n = 10)

Materials	Scores			
	0	1	2	3
Conquest Crystal/Bond 1	4	5	1	0
FloRestore/Tenure Quick	5	5	0	0
Compoglass/Syntac	5	4	1	0
Ketac-Molar Aplicap	6	2	2	0

Leakage was present at the gingival margins in all treatment groups. The results were analyzed using the non-parametric Kruskal-Wallis Test.<sup>16</sup> There was no significant difference among the enamel margins ( $P > 0.05$ ). There was also no significant difference in gingival margins either in all the four groups ( $P > 0.05$ ). Conquest Crystal/Bond 1 showed the least number of zero scores.

### Discussion

None of the restorative systems evaluated in this *in vitro* study completely eliminated microleakage at the gingival margins. Although there were no significant differences among these systems, FloRestore/Tenure Quick (DenMat) consistently reduced gingival marginal leakage more than the other restorative systems. On the other hand, Conquest Crystal/Bond 1 system had the highest leakage score in both enamel and gingival margins, followed by FloRestor/Tenure Quick. This result was not unexpected, since the polymerization shrinkage is higher in composites compared to that in the other systems such as glass ionomer cement or compomer (glass ionomer and composite).<sup>17,18</sup>

The lesser microleakage seen with FloRestore relative to Conquest Crystal may be due to its lower viscosity which allows it to flow at a faster rate to more readily wet the surface causing greater adaptation to tooth structure.<sup>19,20</sup> Compoglass (compomer) contains both glass ionomer (aluminum fluorosilicate glass) and a resin based on dicarboxylic acid dimethacrylate (DCDMA) monomer,<sup>21</sup> hence the polymerization shrinkage is less because it contains less resin and also bonds to the tooth by both chemical and mechanical bonding. The microleakage of Ketac-Molar Aplicap was least as it is a glass ionomer that not only shrinks less than composites or compomers upon setting, but also chemically bonds to tooth structure.<sup>17,18</sup> The manufacturer recommends the use of the Ketac-Glaze which is used as an immediate protective layer after placement of the restoration. The glaze seals the restoration after finishing and polishing to minimize microleakage. This coating may have been another factor contributing to the lesser leakage seen with Ketac-Molar Aplicap.

### Conclusion

1) There was no significant difference in the gingival microleakage among the four systems.

2) Restorations whose marginal finish is on dentin or cementum still presented a microleakage problem.

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