

# Effect of protective coating on marginal integrity of nanohybrid composite during bleaching with carbamide peroxide: A microleakage study

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## ABSTRACT

**Aim:** The aim of the study was to evaluate the microleakage on the marginal integrity of nanohybrid composite during bleaching with carbamide peroxide after applying a protective coating of G-Coat plus (GC, Japan).

**Materials and Methods:** Class V cavities were prepared and restored with nanohybrid composite restoration in 60 freshly extracted noncarious premolars extracted for orthodontic reasons. Then they were divided into 3 groups. Group 1 - bleaching with carbamide peroxide without G coat plus ( $n = 20$ ), Group 2 - bleaching with carbamide peroxide with G-Coat plus ( $n = 20$ ), Group 3 - without bleaching procedure ( $n = 20$ ) (control group). In Group 2, G coat plus was applied over the restorative surface and margins. Then all teeth in Groups 1 and 2 were taken and mounted in dental stone. Bleaching trays were custom fabricated over the cast with the help of a heated vacuum-forming machine. 10% carbamide peroxide (opalescence PF) was applied over the tooth, and the bleaching process was done for about 2 weeks. Then all samples underwent thermocycling and were then immersed in the 2% methylene blue solution for 24 h and observed under a stereomicroscope to evaluate the amount of dye penetration. Data were compared using Kruskal–Wallis test and Mann–Whitney test using SPSS Inc.; Chicago, IL, USA, Version 17.0.

**Results:** Mann–Whitney test shows that the difference in microleakage between Group 1–Group 2 and Group 2–Group 3 is statistically significant ( $P < 0.05$ ).

**Conclusion:** Significant reduction in microleakage was seen in Group 2 when compared to other groups.

**Key words:** Bleaching, G coat plus, microleakage, nanohybrid composite

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Esthetic concern has taken a new high in the field of dentistry, so does the dental materials and patient's knowledge on dentistry. Composite restoration and bleaching are a popular treatment for a patient who desire immediate result in the short duration of time. It has gained further attention after the introduction of home bleaching technique by Haywood and Hayman in 1989, where patients can use it by themselves, with less chair side time necessary to be spent at the clinic.<sup>[1]</sup> Nightguard home bleaching uses a relatively low level of

the whitening agent; mainly carbamide peroxide which is applied to the teeth via a custom-fabricated mouthguard and is worn at night for a duration of at least 2 weeks.

The specific treatment regimen is determined according to individual patient requirements and clinician preference. If the patient does not have any previous restorations, bleaching can be performed without further considerations. However, if restorations are present, the possible effects of oxidative properties of bleaching agents on the restorations must be considered.<sup>[2]</sup> Existing restorations may need to be replaced after bleaching.

Even though they claim nightguard home bleaching with carbamide peroxide to be less expensive and more safe,<sup>[3,4]</sup> various studies have reported the effects of bleaching on the tooth surface and dental restorative materials, like change in color and glossiness of composite,<sup>[5,6]</sup> demineralization of enamel,<sup>[7]</sup> change in the microhardness or hardness, of the enamel,<sup>[8]</sup> and influencing the integrity of dental cements occurs as well.

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All of these studies concluded that there is a significant effect of bleaching on the tooth, as well as composite restoration. If the interface between the restoration and tooth gets affected, it can lead to marginal leakage, loss of structural integrity and secondary caries which ultimately lead to failure of the restoration. To avoid these adverse effects of carbamide peroxide bleaching on composite restoration, a protective layer could be applied over the restoration prior to bleaching. G-Coat plus (GC fuji) is a nano-filled protective coating for glass ionomer, resin composite, and compomer restorations.

Previous studies have confirmed that when applied, the uniformly dispersed film thickness of 35–40  $\mu\text{m}$  provides higher wear resistance, strengthens the restoration, and reduces microleakage.<sup>[9]</sup>

However, the protective effect of G-Coat plus on the tooth structure and restoration interface after bleaching is not reported. Thus, the aim of this study was to evaluate the amount of microleakage occurrence at the interface of the tooth and composite restoration after carbamide peroxide bleaching with and without a protective coating G-Coat plus.

## MATERIALS AND METHODS

Totally, 60 freshly extracted noncarious mandibular premolars extracted for orthodontic reasons were used for the study. Class V cavity (diameter: 4 mm, depth: 2 mm) was prepared on the buccal surface of the premolars with straight fissure bur (SF-13, Mani Inc, Japan) under the water spray.

Cavities were treated with total etch etching gel (Ivoclar Vivadent AG, Liechtenstein) 15 s for dentin and 30 s for enamel, after which it was rinsed off the cavity. Bonding agent Adper single bond adhesive (3M-ESPE, USA) was applied with an applicator tip, left undisturbed for 10 s and allowed to dry. Next coating of bonding agent was applied, and light cured (Blue phase, Ivoclar Vivadent AG, Liechtenstein) as per manufacturer's instruction. Nanohybrid composite (Ceram-x, Dentsply Asia) was then placed into the cavity and light cured as per manufacturer's instruction. Super fine diamond SF101 (Shofu inc, Japan) was used to polish the restoration, and the bur was changed for every five restorations. Then they were divided into three groups:

- Group 1 - bleaching with carbamide peroxide without G-Coat plus ( $n = 20$ )
- Group 2 - bleaching with carbamide peroxide with G-Coat plus ( $n = 20$ )
- Group 3 - with no bleaching procedure ( $n = 20$ ) (control group).

In Group 2, G-Coat plus (GC, Japan) was applied over the restorative surface and margins. Then all teeth in Groups 1 and 2 were taken and mounted in dental stone. This procedure was done for the purpose of fabrication of bleaching tray over the teeth. Bleaching trays were custom

fabricated over the cast using the heated vacuum-forming machine. 10% carbamide peroxide (Opalescence PF, USA) was applied over the tooth, and the bleaching process was done for 8 h/day about 2 weeks.

Then all samples underwent thermocycling from 5°C to 50°C, each cycle lasting for 3 min for 500 cycles. The samples were painted with nail polish leaving 1 mm around the restoration before dye penetration method. Then the samples were immersed in the 2% methylene blue solution for 24 h.<sup>[10,11]</sup> Teeth were sectioned by diamond saw through the center of the restoration buccolingually. The sectioned samples were viewed under a luxeo 4z stereo zoom microscope (Labo America, Inc. USA) to evaluate the amount of microleakage [Figures 1 and 2].

The scoring

- 0 = no penetration
- 1 = penetration of dye to <3<sup>rd</sup> from the margin
- 2 = penetration of dye up to 2/3 from margin
- 3 = penetration of dye up to floor of the cavity
- 4 = penetration of dye up to the center of floor of the cavity.

The Kolmogorov–Smirnov test was applied to verify if the data were normally distributed. Results were compared using Kruskal–Wallis test and Mann–Whitney test using SPSS Inc.; Chicago, IL, USA, Version 17.0.

## RESULTS

Table 1 shows the comparison of microleakage between the three groups under study. Comparing the values using Kruskal–Wallis test shows that  $P < 0.05$ , which is statistically significant. This shows that amount of microleakage due to carbamide peroxide bleaching in tooth without coating is more when compared with bleaching done with the application of G-Coat plus. Table 2 (Mann–Whitney test) shows that the difference in microleakage between Group 1 and Group 2 is statistically significant ( $P < 0.05$ ).

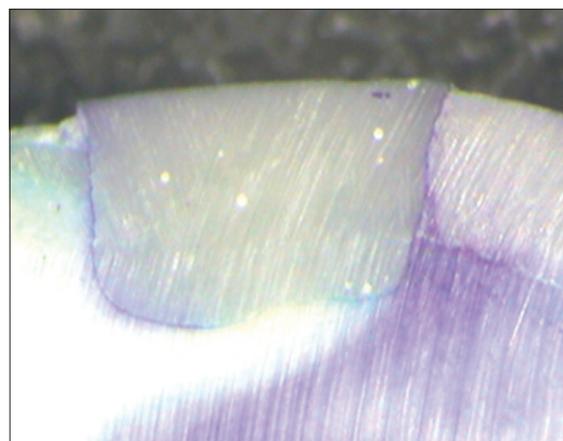
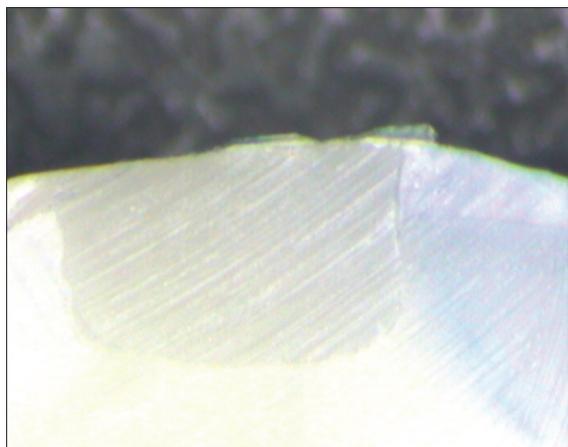


Figure 1: Microleakage without G-Coat plus



**Figure 2:** Microleakage with G-Coat plus

## DISCUSSION

Several studies have evaluated the effect of commonly used bleaching agents on a number of restorative materials since it is of clinical interest. That interest has increased to a greater extent after the use of home bleaching and toothpastes containing carbamide peroxide. In spite of remarkable development in the technology of the resin composite restorative materials with the increased demand for esthetics, clinical failures of such restorations are still continuing. Polymerization shrinkage remains a major disadvantage for composite restorations which produces stress at the adhesive interface and could lead to bonding failure with gap formation. The stress generated could reach up to 10 MPa, leading to a marginal breakdown.<sup>[12]</sup> Microleakage evaluation is the most common method of assessing the sealing efficiency of a restorative material.<sup>[13]</sup>

It is known that carbamide peroxide bleaching causes various adverse effects on the composite restoration. Carbamide peroxide breaks down into urea and hydrogen peroxide and the urea in turn forms free radicals. Hydrogen peroxide and free radicals affect the resin–filler interface and cause filler–resin matrix debonding, thereby increasing surface roughness. There is an increase in microleakage due to the breakdown of marginal integrity between the restoration and tooth.

The inclusion of adhesive monomer in G-Coat plus ensures the full benefits of lamination and protection for restoration margins. Coating with G-Coat plus containing uniformly-dispersed nano fillers, reacts with resin matrix of composite, bonds to the surface, fill voids in the restoration, and forms a dispersion hardened lamination over it for glossy retention and superior wear resistance, which reinforces the outer layer for increased resistance against the surface roughness caused by carbamide peroxide. The infiltration of G-Coat plus provides internal protection against cracks and voids and reduces the microleakage in composite restoration caused by bleaching. Thereby G-Coat plus strengthens and protects the composite by both infiltrating internally

**Table 1: Comparison of median (IQR) of microleakage scores between three groups**

Groups	n	Median	IQR scores	P
1	20	2.00	1	0.04*
2	20	1.00	0.00	
3	20	1.00	0.00	

\*P<0.05 statistically significant. Kruskal–Wallis test. IQR=Interquartile range

**Table 2: Comparison of microleakage scores between group pairs**

Paired	P
Pair 1 - Group 1 and Group 2	0.001*
Pair 2 - Group 2 and Group 3	0.04*
Pair 3 - Group 1 and Group 3	0.27

\*P<0.05 statistically significant. Mann–Whitney test

and coating the composite restoration externally during bleaching. The methyl methacrylate nano resin (40 nm) particles in G-Coat plus flow into the gap and penetrate into dentinal tubules as it is an unfilled resin. Since it adheres to the tooth structure as well as to the composite and effectively seals the adhesive interphase, it gives a good marginal seal during bleaching. By using G-Coat plus during bleaching, microleakage and possible replacement of composite restoration can be thus avoided.

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