

## Effect of 10% carbamide peroxide bleaching gels on surface hardness of nano filled composite resin

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### ABSTRACT

**Introduction:** Home bleaching is the whitening treatment of vital teeth applied by patients themselves at home under dentist supervision. In clinical condition, several patients who need bleaching treatment already had nano filled composite resin restoration on their teeth. The purpose of this study was to investigate the contact time difference of 10% carbamide peroxide bleaching gels application for home bleaching on the surface hardness of nano filled composite resin activated by Light Emitting Diode (LED). **Methods:** Total sample in this study was 30 samples, divided into 3 groups. The samples used were nano filled composite resin cylindrical shape with a diameter of 6 mm and a thickness of 2 mm. Group I as the control group was immersed in distilled water, group II was treated with immersion in 10% carbamide peroxide for 4 hours per day, and group III was immersed in 10% carbamide peroxide for 6 hours per day. The duration of treatment was 14 days for all groups. Data were analysed using Kruskal-Wallis with Mann-Whitney test and the p-value = 0.05. **Results:** The result of one-way Kruskal-Wallis with Mann-Whitney test showed that there were significant difference between the control group and the groups applied with 10% carbamide peroxide for 4 hours and 6 hours per day with the p-value 0.00 ( $p < 0.05$ ). **Conclusion:** Application of 10% carbamide peroxide decreasing the surface hardness of nano filled composite resins activated by LED.

**Keywords:** Nano filled composite resin, carbamide peroxide, composite resin hardness, Light Emitting diode (LED).

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### INTRODUCTION

The teeth appearance determines individual appearance as a whole. Some factors that influence the teeth appearance are teeth colour, shape, position, and quality of the teeth restoration. Teeth colour is one of the factors that

determine individual satisfaction with their teeth appearance.<sup>1</sup>

Teeth whitening procedure (bleaching) can be done by using chemicals and natural ingredients. Generally, chemicals ingredients used in dentistry as teeth whitening products are hydrogen peroxide and carbamide peroxide.<sup>2</sup>

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Carbamide peroxide is more commonly used as a home bleaching agent. The advantage of home bleaching is the application is relatively easy, more affordable, and the rate of its successes is high, but the use of chemicals in teeth whitening procedure is currently still debatable because it might also affect the oral hard and soft tissues.<sup>3</sup>

The use of teeth whitening agents in high concentrations and long periods might cause excessive sensitivity to the teeth and can harm the mucosa and gingiva.<sup>2</sup> Negative effects during teeth whitening can be associated with low pH, oxidation reactions, and the chemical compounds of teeth whitening agents.<sup>4</sup>

Factors that can affect the teeth whitening procedure included the type, concentration, and application duration of teeth whitening material, also, the light and temperature factors. Other factors that also influence are discolouration type, teeth colour before the whitening procedure, plaque and calculus which also has the potential to inhibit the process of teeth whitening. The pH value of the whitening material also affects the teeth whitening procedure. The pH value depends on the material used in the bleaching process.<sup>5</sup> A low pH can erode the enamel surface.<sup>6</sup> Another factor that influences the process of teeth whitening is the duration of whitening materials applied to the teeth. The longer the contact time of teeth whitening material with the surface of the teeth, the more noticeable teeth discolouration will become.<sup>7</sup>

Home bleaching procedure is also indicated for teeth with restoration. One of the materials of tooth restoration is composite resin. Based on the filler particle size, the composite resin is divided into the traditional, small-sized filler, micro-sized filler, hybrid, and nano filled. The later was introduced to the public for aesthetic needs with advantage on a glossy and smooth surface so it is often used for anterior teeth.<sup>8,9,10,11</sup>

Based on the polymerisation process, the composite resin is divided into chemical activated, light-activated and chemical-light activated (dual cure).<sup>8,10,11</sup> Light Emitting Diode (LED) activated composite resin is a new technology to polymerise restoration materials in dentistry and has a positive effect compared to halogen light.

The use of home bleaching in patients with composite resin restoration has generated

controversy regarding the side effects of teeth whitening agents in restorations. Briso et al.<sup>12</sup> states that 15-16% carbamide peroxide can reduce the surface hardness of composite resins. Whilst Prabhakar et.al<sup>13</sup> claims that 10% and 22% carbamide peroxide can reduce the surface hardness of composite resin. Likewise, Campos et al.<sup>14</sup> published that there was no difference in the surface hardness effect of composite resin from several different samples after applying 10% and 15% carbamide peroxide. The purpose of this study was to investigate the contact time difference of 10% carbamide peroxide bleaching gels application for home bleaching on the surface hardness of nano filled composite resin activated by Light Emitting Diode (LED).

## METHODS

The study design was an experimental laboratory with a post-test only control group conducted at the Laboratory of Microbiology of Faculty of Pharmacist and Laboratory of Metallurgy of Faculty of Engineering. The research samples was a disc-like nano filled composite resin restoration with a diameter of 6 mm and a thickness of 2 mm. Total of samples were 30 samples, divided into 3 group, group I as control group (soaked in distilled water), group II as treatment group, applied with teeth whitening materials for 4 hours in 14 days, group III also as treatment group, applied with teeth whitening materials for 6 hours in 14 days.

The material used in this research was nano filled resin composite type Z350XT from 3M, teeth whitening material with brand Opalescence which contains 10% carbamide peroxide, and aquabides (distilled water). The tools used for this study were mould from stainless steel (6 mm diameter and 2 mm thick), Gnatus brand LEDs, plastic instrument, press materials, incubator 37°C, Shimadzu brand Vickers hardness test with, Micro Hardness Tester Type-M, cellophane strips, handsocon, mask, Petri dish, and board marker.

Procedure of this research showed in Figure 1, with descriptions as follows: (1) Fabrication of master model: Master model was made with moulds 6 mm in diameter and 2 mm thick; (2) Sampling procedure: The sample was divided into 3 groups; Group I as a control group consisted of 10 samples that were immersed in distilled water for



## DISCUSSION

The results presented in Table 1 suggested that there was a decrease in the surface hardness after bleaching with 10% carbamide peroxide for 4 and 6 hours compared to the control group (immersed in dis-tilled water). Control group had significant difference with group III, which was applied with whitening ma-terials for 6 hours in 14 days and decreased up to 6.67 VHN; while the control group decreased up to 4.96 VHN compared with group II. The results also showed how the contact time of 10% carbamide peroxide influenced the surface hard-ness of nano filled composite resin. The data showed that the longer the contact time of 10% carbamide peroxide, the higher the decrease of surface hardness of nano filled composite resin.

Clinically, 10% carbamide peroxide and 35% hydrogen peroxide showed a different effect on the teeth sensitivity. Sensitivity will happen until 24-48 hours after the application of teeth whitening materials. Peroxide was detected in pulp 15 minutes after the enamel was exposed by 35% hydrogen peroxide. An in-vivo research procedure conducted with 10% carbamide peroxide using the home bleaching technique showed that the pulp condition was not changed to irreversible condition.<sup>15,16</sup> Therefore, the use of 10% carbamide peroxide is more safe and effective for the teeth whitening procedure. The result of the present research was similar to a research conducted by Campos et al<sup>14</sup>, which discovered that composite resin contacted with teeth whitening material such as carbamide peroxide in the long term would have a decreasing surface hardness.

Kruskal-Wallis and Mann-Whitney Test results presented in Table 2 showed the significant difference be-tween control group and group applied with 10% carbamide peroxide, and there was also a significant dif-ference between group that applied with 10% carbamide peroxide for 4 hours and 6 hours; which was con-sistent with research conducted by Tjuatja<sup>9</sup>, Briso<sup>12</sup>, and Prabhakar<sup>13</sup>, which discovered that hydrogen peroxide contained on carbamide peroxide that used for teeth whitening procedure affected significant decrease of surface hardness of composite resin.

Prabhakar<sup>13</sup> stated the use of 10% and 22% carbamide peroxide procedure affected a significant decrease in surface hardness of

composite resin. 22% carbamide peroxide had more impact in decreasing the surface hardness compared to 10% carbamide peroxide on composite resin that applied for 8 hours per day in 14 days.<sup>13</sup> Briso<sup>12</sup> also stated that the use of 16% carbamide peroxide from different whitening product brands such as Review™, Magic Bleaching™, Opalescence™, Whiteness Product™ and Claridex™ also affected signifi-cant decrease of surface hardness of composite resin that applied for 6 hours per day in 14 days. The results of two later research was similar to the result of the current research.

Peroxide group in hydrogen peroxide will absorb more H<sub>2</sub>O molecules and will be diffused into polarised resin matrix, and this action will cause detachment of resin molecules and lead to resin matrix swelling. Swelling in the composite resin can cause pressure around resin composite filler, thus continues to structural degradation and ends up to the break of Si-O-Si bonds which bind the particle with silane (coupling agent). The rupture of Si-O-Si bond will also cause proton migration which will form Si-O bond, where the remaining of Si<sup>-</sup> atoms will bind with peroxide group from hydrogen peroxide. In the longer contact time, further degradation by peroxide will occur and able to cause the plastification of the resin matrix surface.<sup>9,10</sup>

Degradation of chemical composite resin structure not only affected the decrease of surface hardness but also cause microleakage activity, surface roughness and colour stabilisation on the composite resin.<sup>17-20</sup> Ellias and Sajjan<sup>17</sup> stated that teeth whitening materials formed microleakage between the teeth surface attachment and composite resin restoration. Microleakage is one of the causes of secondary caries through the initial procedure of the penetration of saliva liquid contained bacteria in restoration borders.<sup>17</sup> Roughness surface of composite resin restoration is related to plaque retention, plaque accumulation, and biofilm formation, that will trigger secondary caries. A study suggested that bacteria colonisation was formed from the rough restoration surface.<sup>11,12</sup> Ellias and Sajjan<sup>17</sup> suggested that hydrogen peroxide predication causes protein denaturation on organic material of dentin and enamel. Therefore, the ratio of organic components more increased compared to inorganic components thus change the enamel and

dentin surface morphology and formed surface porosity.<sup>17</sup>

Porosity will affect the surface roughness of enamel and composite restoration. Wang et al<sup>20</sup> suggested that the surface hardness of the tooth enamel and composite resin had significant differences after teeth whitening procedure. This research was found that the effect of teeth whitening materials provided more impact on the roughness surface of composite restoration compared with the tooth enamel.<sup>20</sup> This condition happened due to the broken chain of matrix and filler caused by free radicals of peroxide, thus leads to microscopic cracks and modification surface hardness of composite resin restoration. Li et al<sup>19</sup> showed the period of teeth whitening materials application to composite resin restoration impact in increasing free radical of peroxide and increased the broken chain of matrix and filler and finally altered the surface roughness of composite resin restoration.<sup>19</sup>

## CONCLUSION

Application of 10% carbamide peroxide bleaching gels used in home bleaching decreasing the surface hardness of nano filled composite resins activated by LED.

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