Effect of a 16% Carbamide Peroxide Bleaching Gel on Enamel Staining Susceptibility

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Abstract:
Statement of Problem: Due to the growing popularity of vital bleaching by Carbamide Peroxide it is imperative to understand the effect of such agents on enamel and dentine.
Purpose: The purpose of this study was to evaluate the effect of a 16% carbamide peroxide bleaching gel; Vivastyle on enamel staining susceptibility.
Materials and Methods: Thirty bovine specimens were selected and randomly divided into two groups of fifteen. The experimental group was subjected to Vivastyle gel and then was immersed in coffee, for half an hour daily for three weeks. The control group was only immersed in coffee. The teeth were evaluated by colorimeter readings to measure $L^*$, $a^*$, $b^*$ of each tooth. Total color differences between two colors ($\Delta E$) were calculated using the following formula:

$$\Delta E = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2}.$$  

$\Delta E_1$ represent color difference after bleaching; $\Delta E_2$: bleached and immersed in coffee, and $\Delta E_3$ immersed in coffee.

Results: Mean color difference were: 9.478, 13.808, and 7.230 for $\Delta E_1$, $\Delta E_2$, and $\Delta E_3$ respectively. Paired comparison by Duncan test showed that there was a significant difference between $\Delta E_1$ and $\Delta E_2$ ($P=0.000$). $t$-test showed that there was no significant difference between $\Delta E_3$ and $\Delta E_1$ ($P=0.08$), however, $\Delta E_3$ had significant difference with $\Delta E_2$ ($P=0.000$).

Conclusion: After vital bleaching, the enamel staining susceptibility is significantly increased.

Key words: Staining susceptibility; Enamel; Carbamide peroxide; Vital bleaching

INTRODUCTION

Vital bleaching with carbamide peroxide is becoming more and more popular, showing good clinical long-term results [1] Some scanning electron micrographic evaluations of natural teeth have indicated that no major changes in surface texture accrue when teeth are bleached with 10% carbamide peroxide [2,3,4], although many studies have evaluated the potential adverse effects of carbamide peroxide agents. When using SEM evaluations, some changes on enamel and dentin surface morphology have been reported [5-8]. There are scientific reports that demonstrate alterations in composition of bleached enamel [9]. Vital bleaching agent may result in reduction of the calcium and phosphate contents, accompanied by a decrease in the quantity of fluoride in enamel [10, 11]. In contrast to these findings, Crews et al, described an increase in the amount of calcium and phosphate in enamel after vital
bleaching [12].
In a previous study, it has been shown that the loss of micro hardness in bleached enamel could be compensated by a remineralization period following bleaching [13]. This remineralization was accomplished by immersing the bleached enamel in artificial saliva. It is therefore speculated that in this case micro structural defects may be repaired by the adsorption and precipitation of components such as calcium and phosphate present in saliva.

It is well-known that some dietary factors, such as coffee and tea lead to extrinsic tooth discoloration [14]. This discoloration is dependent on various parameters, such as the acidity of the staining solution. The low pH value of coffee and tea is reported to increase staining as compared with chlorhexidine which is less acidic [15].

The aim of this study was to evaluate the effect of a 16% carbamide peroxide bleaching gel on enamel staining susceptibility.

MATERIALS AND METHODS
Thirty bovine incisors were selected. They were randomly divided into two groups: Experimental group (n=15) and control group (n=15) and were kept in room temperature for ten days. Extrinsic stains of the teeth were removed with a dental prophylactic agent using Nupro prophylaxis fluoride paste (Dentsply, Preven-tive care, York, PA 1704, USA). The prophylaxis was performed at least two weeks prior to commencing the active study phase. Then specimens were stored at 100% humidity and 37°C temperature. In experimental group, the roots of the teeth were embedded in acrylic resin blocks. The cementum adjacent to the exposed enamel was sealed with nail varnish. A thin plastic night guard (Coping Material # 31720, Buffalo Mfg Co.) was fabricated using a vacuum-forming machine (STA-Vac, Buffalo Mfg Co.) for each acrylic resin block.

Two drops of a 16% carbamide peroxide gel, Vivastyle (Ivoclar Vivadent AG, Benderer-strass, Liechtenstein) were placed in each tooth formed night guard, and the night guard was seated on the acrylic resin block. The teeth were kept at 100% humidity and 37°C. The specimens were subjected to Vivastyle gel for a period equivalent two weeks of night time wear followed by storing in artificial saliva with the composition of 1% sodium chloride, 1% albumin and 0.1% sodium azide. After bleaching treatment was completed, the protective coating was removed from the teeth. All samples were rinsed with distilled water.

The teeth were evaluated using a colorimeter (Chroma Meter Model SR-321 Minolt, Ramsey, NJ 07446, USA) to measure L*, a* and b* of each tooth. Each tooth was measured three times in non-consecutive order. Then the specimens were immersed in coffee for half an hour every day and subsequently stored in artificial saliva, for three weeks [21]. The teeth were rinsed and further evaluated using the same colorimeter as explained above.

The mean value was considered as the real color value. The L*, a* and b* color space system has been defined by the commission International de I, EClairage in 1979 and is referred to as CIE LAB (International commission on Illuminations 1978).

Collected data were analyzed statistically using Duncan and t-test (α = 0.05).

RESULT
Mean color differences are shown in Table I. The mean color difference of ΔE and ΔE2 were compared using a paired comparison analysis of Duncan test (α=0.05). Results
revealed that there was a significant difference between $\Delta E_1$ and $\Delta E_2$ ($P<0.05$).

<p>| Table I: Mean color differences and standard deviations in three sets of measurement. |</p>
<table>
<thead>
<tr>
<th>Number</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta E_1$</td>
<td>15</td>
<td>9.4784</td>
</tr>
<tr>
<td>$\Delta E_2$</td>
<td>15</td>
<td>13.8086</td>
</tr>
<tr>
<td>$\Delta E_3$</td>
<td>15</td>
<td>7.2300</td>
</tr>
</tbody>
</table>

$t$-tests showed that there was a significant difference between $\Delta E_3$ and $\Delta E_2$ ($P<0.05$) however, significant difference between $\Delta E_3$ and $\Delta E_1$($P=0.08$) was not documented (Fig.1).

DISCUSSION
Staining susceptibility of bleached enamel after immersion in coffee was examined and compared in this study. Due to their similarity in structure and chemical composition to human teeth [16], bovine teeth were used in this study.

The surfaces of the samples were not ground before experimentation, since the intention of this study was to investigate the teeth under natural conditions. However, the presence of natural variations in the enamel surface texture, might have led to a discrepancy in stain adsorption.

The samples underwent their respective treatment for fourteen consecutive days with sporadic immersion in artificial saliva. Storage in saliva was chosen in order to simulate the remineralization of the bleached specimens [17]. For standardizing the conditions of study, the artificial saliva was used instead of human saliva. The 8-h period of bleaching was chosen to simulate wearing of a night guard filled with the bleaching agent. Storage time of the samples in coffee after the bleaching procedure imitated the every day situation with consumption of coffee for 30 minutes and represents a longer period as compared with the presumably shorter contact of the teeth with coffee during drinking [18]. However one study has indicated that teeth had higher susceptibility to staining by tea than coffee or chlorhexidine [19].

After two weeks of bleaching with 16% Vivastyle the CIE LAB $\Delta E^*$ revealed lightening of the specimens when compared with unbleached samples ($\Delta E_1=9.4784$). This is in accordance to some previous studies [18, 20, 21, 22]. Although after immersion in coffee the samples showed higher $\Delta E$ value as compared with that of bleached enamel ($\Delta E_2=13.8086$), one recent study showed that the immersion of bleached enamel in tea in different intervals could not have an effect on increasing the $\Delta E$ [23]. $\Delta E$ value greater than one or two units represent a color change that may even be observed by the naked eye [24]. The less $\Delta E$ value represents the lighter color of subject [20]. Paired $t$-test illustrated a significant difference between $\Delta E_1$ and $\Delta E_2$ ($P<0.05$). It also demonstrated a significant difference between $\Delta E_3$ (7.230) and $\Delta E_2$ (13.806) ($P<0.05$).

The lowest change in the $\Delta E$ values was recorded for the control group and the highest was observed in “bleached enamel and immersed in coffee” group. This means that the application of Vivastyle followed by the
immersion in coffee resulted in higher staining of the specimens when compared with the control group. \( t \)-test showed that \( \Delta E_3 \) (7.230) had no significant difference with \( \Delta E_1 \) (9.478) (\( P>0.05 \)). This means that neither the bleaching agent nor the coffee have an effect on the original color of the teeth. Therefore, a high value of \( \Delta E_3 \) was probably due to irregularities on the enamel surface.

A SEM evaluation demonstrated alterations in surface of enamel after vital bleaching, indicating exposure of the enamel prismatic layer, frequently as deep as the enamel rods but seldom the dentin [6]. These changes in enamel and dentin may lead to more penetration of bacteria and pigments necessitating rebleaching [6]. Attin et al claimed that contact of bleached enamel with tea leads to some extrinsic stains which are not macroscopically detectable and should be totally removed by cleaning the samples [23]. Further studies are necessary to evaluate the best way to decrease the staining susceptibility of bleached enamel.

CONCLUSION

1– There was a significant tooth color difference between the bleached teeth and those immersed in coffee after bleaching.

2– There was a significant difference in tooth color between teeth immersed in coffee and the group that were first bleached and then immersed in coffee.

3– No significant color difference was observed between bleached teeth group and the group that only immersed in coffee.

ACKNOWLEDGMENTS

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اثر زل بلیچینگ کاربامید پراکساید ۱۶٪ بر رنگ‌پذیری میتا

م. قوام‌نصیری ۱-م. حبیبی راد

چکیده

پیش‌زمینه: به دلیل گرایش روزافزون به روش vital bleaching با استفاده از کاربامید پراکساید، بررسی اثر این عوامل بر میتا و عاج ضروری به نظر می‌رسد.

هدف: مطالعه حاضر با هدف تعیین اثر یک نوع تجاری زل کاربامید پراکساید (Vivastyle) بر رنگ‌پذیری میتا انجام شد.

روش تحقیق: تعداد ۴۰ تنداز که به طور تصادفی به دو گروه تقسیم شدند. در گروه داخلی در تیم ساعت در قهوه غوطه‌ور شدند. در گروه شاهد نمونه‌ها فقط به روش مشابه گروه اول در Qهوه غوطه‌ور شدند. این تست با استفاده از کلریتر (colorimeter) در هر دنیا به دست آمد و تفاوت نسبت به محمدینه با 

\[ \Delta E = \sqrt{\Delta L^2 + \Delta a^2 + \Delta b^2} \]

در این تحقیق، \( \Delta E \) به عنوان پیش از بلیچینگ و قرار دادن در قهوه و \( \Delta E \) به عنوان پس از بلیچینگ و هم چنین قرار دادن در قهوه و \( \Delta E \) به عنوان پس از قهوه در نظر گرفته شد.

نتیجه‌گیری: پس از بلیچینگ قابلیت رنگ‌پذیری میتا به طور معنی‌داری افزایش می‌یابد.

واژه‌های کلیدی: رنگ‌پذیری میتا؛ کاربامید پراکساید; بلیچینگ

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