Comparison of Colour Changes on Tooth using Chemical and Light Activated in Office Bleaching Agents- An in Vitro Study

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ABSTRACT

Introduction: Tooth discoloration creates wide range of cosmetic problems. various methods are available to remove stains. One of those methods is tooth bleaching which can be done by vital or non vital methods. Bleaching process involves use of hydrogen peroxide, carbamide peroxide, sodium perborate. These bleaching agents can be activated by chemical, heat, light. The aim of the present study was to compare the bleaching efficacy of light activated and chemically activated bleaching agents.

Material and Methods: Twenty freshly extracted teeth were selected. They were sectioned into dentinal slabs of 5mm length and 5mm height in incisal region. Dentinal slabs were allotted to two groups: one group was subjected to light activated bleaching by Natural+^{tm},other group was subjected to chemical activated bleaching Opalescent Boost 38%. Color of samples before and after subjecting to bleaching was measured using colour flex spectrophotometric analysis.

Results: ΔE values obtained from CIElab spectrophotometric analysis showed that there was significant differences between light activated bleaching agents and chemically activated bleaching agents.

Conclusion: Light activated bleaching agents showed higher ΔE values than chemically activated bleaching agents.

Keywords: Light activated bleaching, chemically activated bleaching, spectrophotometer, CIELab system

INTRODUCTION

Tooth discoloration creates a wide range of cosmetic problems. The methods available to manage discoloured teeth range from Removal of surface stain, Bleaching or tooth whitening techniques, Operative techniques to camouflage the underlying discoloration, such as veneers and crowns.

At present there is significant rise in acceptance and demand for treatment of other wise healthy teeth to make them brighter and whiter. The single most common esthetic treatment for adults is bleaching. Bleaching is simplest and least invasive, least expensive means available to lighten the discolored teeth and diminish or eliminate stains in both vital and non vital teeth.

Earliest reported bleaching agent was oxalic acid described by chapel in 1877. First use of hydrogen peroxide was in 1884 by Harlan. The bleaching agents that are present today are hydrogen peroxide, carbamide peroxide and sodium per borate. Bleaching techniques are of two types vital bleaching technique for healthy tooth to remove surface and intrinsic strains[1] and non vital bleaching techniques for pulp less tooth. These agents break down the larger pigment molecules with conjugated double bonds into smaller less pigmented ones.[2]

There is several in office bleaching techniques of vital teeth. All are based on use of concentrated hydrogen peroxide. There are number of concentrated bleaching gels that can be used, some utilizes heat and light to speed up the reaction some uses chemical method. The aim of this study was to compare light activated bleaching agents to chemically activated bleaching agents.

MATERIAL AND METHODS

Twenty maxillary anterior tooth selected randomly extracted for various reasons that were not related to this study were collected from department of oral and maxillofacial surgery. The study was performed at G.PullaReddy dental college and hospital Kurnool. All the surface debris of tooth were removed by using scalar and were stored in physiological saline until the time of study. Teeth were sectioned such that dentinal slabs of length 5mm, breadth 5mm and thickness of 2mm were obtained using water cooled slow speed saw.

The dentinal slabs were attached to holder and sequentially polished using aluminium abrasive papers of 1200, 2400, 4000 grit sand papers to remove 0.1mm of enamel. Soluble coffee solution was prepared using 25gms of powder to 250 ml of water. The specimens were immersed in coffee solution for seven days. These dentinal slabs were divided into two groups with sample size 10; Group A, subjected to opalescence boost chemically activated bleaching agent and Group B, subjected to Natural +^{tm} light activated bleaching agents (Table-1).

Before subjecting to bleaching agent, the base line L*values of each specimen was assessed under standardized ambient conditions according to Commmission Internationale de I'Eclariage (CIE) L*a*b* system using colorflex spectrophotometer. The color of each specimen is measured three times and averaged. The results of color was quantified in terms of three coordinates L*a*b* as established by CIE which locates the color in three dimensional space. L* axis represents degree of lightness with in sample. a* represents the degree of green/red color, while b*represents degree of blue/ yellow color with in a sample. Table 2 shows L* a* b* values before application of bleaching agents.

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Product	Composition	Activator
Opalescence Boost	H_2O_2 38 %, flouride,potassium nitrate, thickening agent, pH=7.52	Potassium hydroxide
Natural+tm	35 % Hydrogen Peroxide, PEG, Silica,	Activator: Sodium Hydroxide, Dye and light emitting diode emiting high intensity blue light

Table-1: Components of bleaching agents used in the study.

	L*	a*	b*
A	0.659	0.414	0.839
B	0.612	0.505	0.815

Table-2: L*a*b* values of samples before subjecting to bleaching agents

	L*	a*	B*
A	0.759	0.486	0.737
B	0.937	0.742	1.716

Table-3: L* a* b* values after subjecting to bleaching agents.

	ΔL*	Δa*	Δb*	ΔE
A	0.1	0.072	-0.093	0.276
B	0.377	0.240	0.334	0.8398

Table-4: ΔE values of both groups

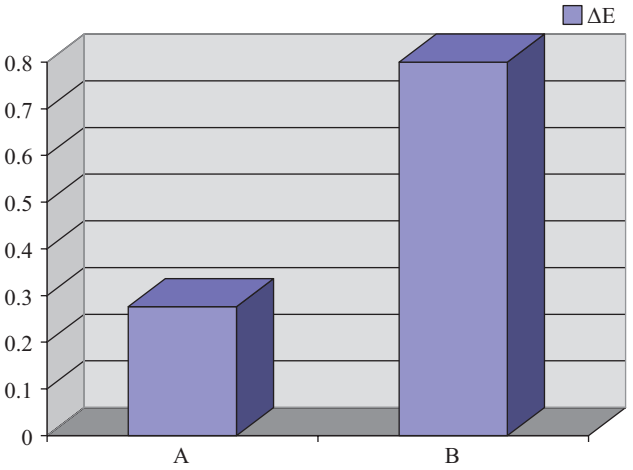

Figure-1: Bar diagram showing net change in color of both groups after subjecting to bleaching agents

In group A, base paste and activator paste of opalescence boost chemically activated bleaching agent were mixed with each other until the homogenous mix was obtained. The resulting paste was applied onto facial surface of dentinal slabs and left untouched for 15 min. The process is repeated thrice.

In group B, base paste and activator paste was mixed with each other until the homogenous mix was obtained and is applied on facial surface of dentinal slabs. They were left undisturbed for 7 to 8mins and then activated by bleaching light for half an hour. The specimens were stored in physiological saline for seven days and L* a* b* values were obtained. They are shown in table 3. ΔE values of both groups were shown in table-4.

The net change in color of the samples is given by formula.

$$\Delta E_{A} = ((\Delta L_{2A} - \Delta L_{1A})^2 + (\Delta a_{2A} - \Delta a_{1A})^2 + (\Delta b_{2A} - \Delta b_{1A})^2)^{0.5}$$

$$\Delta E_{B} = ((\Delta L_{2B} - \Delta L_{1B})^2 + (\Delta a_{2B} - \Delta a_{1B})^2 + (\Delta b_{2B} - \Delta b_{1B})^2)^{0.5}$$

STATISTICAL ANALYSIS

SPSS version 21 was used for statistical analysis. Data was subjected to wilkoxon sign rank test.

RESULTS

*L represents change in lightness of an object.*a represents -, green or +, red and *b represents -blue or +yellow color. The net change in color of samples after bleaching agent application was observed. All the three components of the color was significantly increased after the light activated bleaching agent is applied when compared to chemically activated bleaching agents. P value is 0.00532, standard deviation of group A is 0.2 and group B is 0.5. The net change in color is represented in figure-1.

DISCUSSION

Bleaching is a chemical process of whitening a tooth. Bleaching process works by oxidation of organic substance into corbon-dioxide and water. The oxidation reduction reaction which take place in bleaching is said to be redox reaction where oxidizing agent gives up free radicals and become reduced, reducing agent takes up free radicals and gets oxidized.

Hydrogen peroxide prodces free radicals, HO_2*+O*. O* is weeker free radical and produced in large quantities when solution is activated by light and heat. HO_2* is stronger free radical produced in large quantities when solution is activated by anionic dissociation which occurs in opalescence boost.

Previous studies stated that by decreasing the pH of bleaching agents more dissolution of dentin and less significant change in color was noticed. Neutral or alkaline bleaching agents caused less change in chemical composition of dentin. Both bleaching agents used in this study were of neutral pH, hence effect of ph is eliminated.

Light energy is transformed into heat and may accelerate the process of color recovery.[2] light energy produces generation of weaker free radicals which cause less damage to tooth structure. As per the studies Adriana Desilva et al,.light energy does not effect the permeability of enamel topography and its mineral content. when different light sources were used as catalysts quartz tungsten lamp, lasers, plasma arcs produced more rise in intra pulpal temperature in contrast to LED.[3,4]

Arantza Dominguez et al. examined the whitening efficacy of six different photo activation systems in combination with three different whitening agents. Light sources were halogen lamp, light-emitting diode (LED), low-power diode laser, and neodymium: yttrium–aluminum–garnet (Nd:YAG), second harmonic of Nd:YAG, and Er:YAG lasers. LED has proven to be best light source.[5]

Joe. C Onteveros, Rade D Paravina in 2009, performed a study evaluating the colour change produced by bleaching performed with and with out supplementary light. From the study it was shown that bleaching performed with aid of supplementary light resulted in significant change in color.[6]

Adriana da silva in 2014 performed a study which showed that

light activation of bleaching agent with LED or halogen lamp did not caused an significant changes in surface mineral content of enamel when compared to effects produced when bleaching agent was used alone.[7]

Chemically activated bleaching agents undergoe anion then dissociation which results in generation of stronger free radicals that cause loss of tooth mineral and sensitivity. Both the bleaching agents used in present study has neutral ph to avoid the effects of decrease pH. During the bleaching process highly pigmented carbon rings in organic matter were opened, carbon-carbon double bonds were broken and were converted to hydroxyl group which were lighter.

Tooth samples are taken from incisal two thirds were taken as they have more thicker dentin,Several methods were used to compare visually the tooth color some of them are tooth color shade guides, image analysis, colorimeters, or spectrophotometers. The present study used the spectrophotometer as it gives precise L* a*b* values. It contains a source of optical radiation, a detector, an optical system for measuring, a means of dispersing light, a means of converting a light into measurable signal. when compared to human eye and/or conventional techniques spectrophotometer 33% increase in accuracy and 93.3% increase in more objective match.[8]

As per previous studies Coffee is used in this study as staining agent because it is frequently consumed. It has strong potential to stain the teeth. The specimens immersed in coffee are stained yellow and decreased lightness. It caused significant color alterations of tooth.[9] The physiological saline is used to maintain dentinal slabs rehydrated. Results of present study showed that, there ΔE values were increased after light activated bleaching agents than chemically activated agents.

CONCLUSION

With in the limitations of this investigation, it is concluded that light activated in office bleaching agent produced significant improvement in color than chemically activated in office bleaching agents.

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