

Effect of Antioxidants In Reducing Microleakage of Composite Restoration In Intracoronally - Bleached Teeth

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Abstract

The esthetic concern in the field of conservative dentistry demands the combined usage of bleaching and composite restoration. After bleaching, the residual oxygen left by the bleaching agent inhibits the polymerization of resin hence delayed composite restoration is usually followed. Few reports have indicated that application of antioxidant into the access cavity of intracoronally bleached tooth allows immediate composite restoration.

Keywords: Sodium hypochlorite; sodium ascorbate; alpha tocopherol; EDTA (Ethylenediaminetetraacetic acid)

Introduction

The need for better esthetics has been evolving with the contemporary dentistry, patient's desire for natural smile and brighter teeth has produced the demand for various esthetic procedures. One among those procedure is the

bleaching (teeth whitening) procedure. Bleaching using carbamide peroxide has gained popularity as one of the esthetic treatment modality.

In spite of the recent emphasis on masking of discolored teeth with veneers, there is still a good deal of interest in bleaching of stained teeth³ there is a difference in the surface of the enamel due to the alteration by the bleaching procedure⁸ Several adverse effect of bleaching agents consists of changes in the ultra-morphological structures of enamel and the change in the structural properties such as hardness, toughness, brittleness^{4,5}.

Use of the acid-etch technique on bleached enamel with normal bond strength values has been a challenge for esthetic dentistry. The bleached enamel surfaces, has reduced physical properties, such a reduced shear bond strength on comparison to unbleached enamel, the

interfaces between resin and bleached enamel as seen on SEM examination are substantially different from those formed between resin and unbleached enamel^{4,5}.

A certain waiting period is required to allow a gradual elimination of residual oxygen from the bleached surface before adhesive restoration⁶. It has been said that, the composite restoration when delayed for 7 days after bleaching, the composite restoration bonding increased up to the level obtained in the non-bleached control. It has been reported that the application of sodium ascorbate antioxidant into the access cavity of intra-coronally-bleached tooth allows immediate composite restoration after non-vital bleaching through its ability to remove oxygen radicals².

The reaction between sodium ascorbate and hydrogen peroxide occurs as rapidly as 5 minutes after mixing together, and allows bonding procedure to begin soon without the usual waiting period⁷.

Data and Sources of Data

Seventy two extracted, human premolar teeth were collected from the Department of Oral and Maxillofacial Surgery, A.J Institute of Dental Sciences, Mangalore and other private clinics in Mangalore and Tamilnadu, adhering to CDC Infection Control Protocols Global, with the informed consent of the patients. After cleaning the teeth of all surface deposits and blood, they were examined by trans-illumination to rule out any cracks or defects in them. They were stored in 0.9% saline.

Methodology

A total of 72 human premolars free of caries, restoration and cracks were collected adhering to the infection control protocol, all the teeth were thoroughly cleaned free of debris and calculus using scalers and were stored in isotonic saline. Access opening was done using endo access bur. The canals are prepared using rotary instrument by step down technique and obturated.

Guttapercha was removed to ensure a 10mm cavity depth and at least 2mm thick glass ionomer base over the root filling, followed by internal bleaching by placing it in a mixture of 30% hydrogen peroxide and sodium perborate into the pulp chamber for 7 days, the bleaching solution is removed and cavity washed with water and all the teeth will be randomly divided into 6 groups of 12 teeth each:

Group I: Immediate composite restoration will be done by drying the tooth initially, followed by acid etching with 37% phosphoric acid for 20 seconds, bonding agent will be applied and cured for 20 seconds, shade selection will be performed, composite material will be added in increments and cured for 40 seconds

Group II: Delayed composite restoration done using the procedure followed in group I after one week

Group III: Was treated with 10% sodium ascorbate for 10 minutes and followed by composite restoration same as group I

Group IV: Was treated with 35% sodium ascorbate for 10 minutes and followed by composite restoration same as group I.

Group V: Was treated with 10% alpha tocopherol solution for 10 minutes and followed by composite restoration same as group I.

Group VI: Was treated with 35% alpha tocopherol solution for 10 minutes and followed by composite restoration same as group I.

All the specimens were stored in distilled water at 37 degree Celsius for 24 hours.

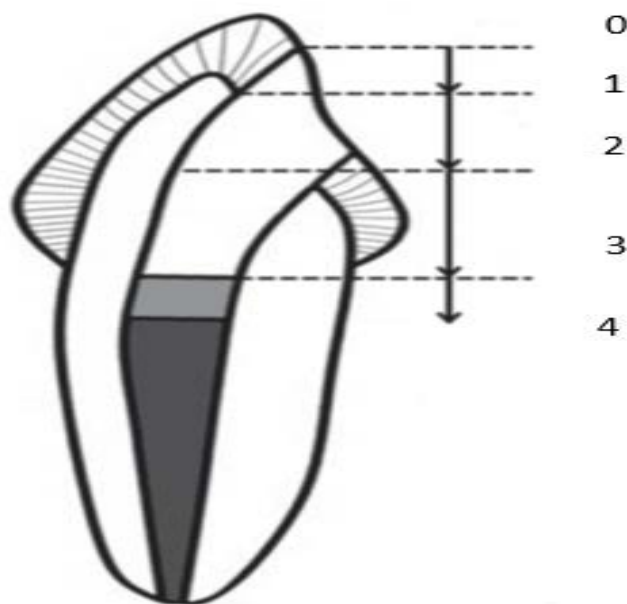
Composite restoration was finished and polished, the specimen were subjected to 500 thermal cycles between water baths of 5 and 55 degree Celsius, specimen were covered with two coats of nail varnish except 1mm around the tooth restoration interface.

The root apices were sealed with utility wax and immersed in 1% methylene blue for 8 hours, teeth were washed in tap water.

Nail varnish and utility wax were removed with scalpel, teeth were sectioned longitudinally from labial to lingual through the centre of the restoration using a low speed diamond saw.

Micro leakage assessed under stereomicroscope and graded from 0 to 4, the micro leakage data was analyzed.

Figure 1: Grading of micro leakage score



Statistical Analysis

Collected data was analysed by computing by the application of ANOVA followed by KRUSKAL-WALLIS. A statistical package SPSS version 17.0 will be used. $P < 0.05$ will be considered as significant.

Table 1: Distribution of the micro-leakage among the groups

		Micro leakage					Total
		0	1	2	3	4	
Group 1	Count	0	0	1	8	3	12
	Percent	0.0%	0.0%	8.3%	66.7%	25.0%	100.0%
Group 2	Count	3	4	4	1	0	12
	Percent	25.0%	33.3%	33.3%	8.3%	0.0%	100.0%

2	Percent	25.0%	33.3%	33.3%	8.3%	0.0%	100.0%
Group 3	Count	1	5	6	0	0	12
	Percent	8.3%	41.7%	50.0%	0.0%	0.0%	100.0%
Group 4	Count	5	5	2	0	0	12
	Percent	41.7%	41.7%	16.7%	0.0%	0.0%	100.0%
Group 5	Count	3	7	2	0	0	12
	Percent	25.0%	58.3%	16.7%	0.0%	0.0%	100.0%
Group 6	Count	7	4	1	0	0	12
	Percent	58.3%	33.3%	8.3%	0.0%	0.0%	100.0%
Total	Count	19	25	16	9	3	72
	Percent	26.4%	34.7%	22.2%	12.5%	4.2%	100.0%

Figure 2: Distribution of microleakage among group

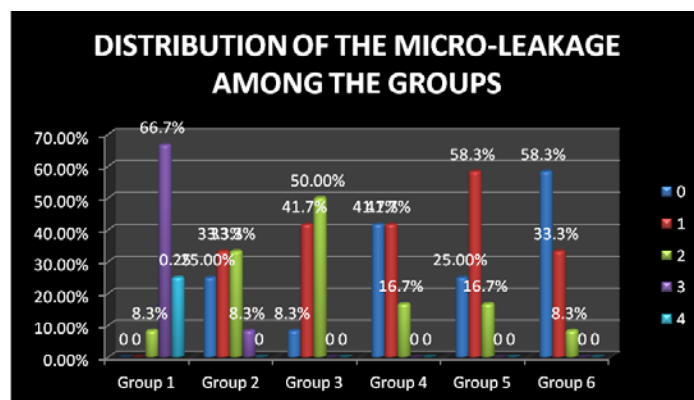
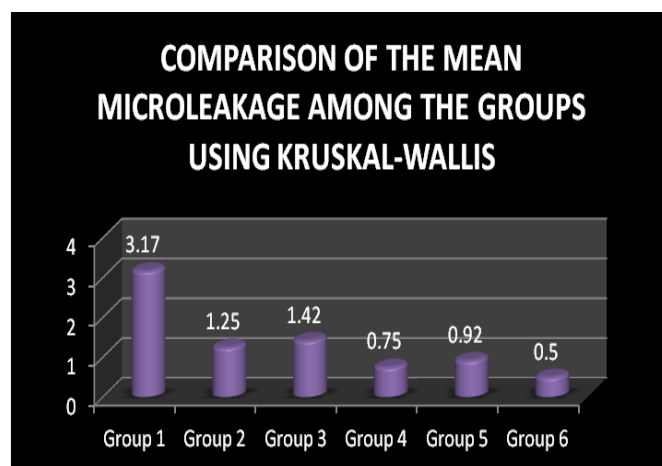


Figure3: Comparison of the mean microleakage among the groups



Results

Group VI (35% alpha tocopherol) showed mean score of 0.5 compared to the control group I and group II which should mean score of 3.17 and 1.25 respectively.

Group III showed mean score of 1.42 which is higher than that of group II. However Group IV showed mean score of 0.75 which is significantly lower to that of group I & II.

Discussion

Intra coronal application of bleaching agents has been successful in whitening crowns of a non-vital tooth treated endodontically. Although the immediate success is appreciated, however after a period of 5 years the esthetical satisfaction decreases by 35 to 50% due to the microleakage of the restoration²⁷.

Oxygen is proven to inhibit the bonding of unfilled resin. The effect of oxygen is pronounced to produce an inhibited zone on the surface of the resin when it contacts the room air. The thickness of the inhibited layer could be related to monomer composition and activating systems. Those materials having lower viscosities as a result of greater diluent content had greater thickness of unpolymerized resin^{10,12,13}.

There is a substantially greater potential for polymerization shrinkage during curing than is seen with the composite materials. Polymerization shrinkage could compromise the enamel/resin bond strength and increase the potential for microleakage¹⁶ colour regression occurring due to the ingress of fluids inside the restored cavity, causing aesthetic and restorative failure

The use of bleaching agent such as sodium perborate with hydrogen peroxide 30% will affect the bonding adversely causing microleakage and failure¹⁸, the effect of bleaching agent such as carbamide peroxide has been researched so far, less evidence has been presented on the bleaching by sodium perborate and hydrogen peroxide on microleakage, since the effect of sodium perborate has more bleaching action, therefore sodium perborate and 30% hydrogen peroxide is used in this study.

Bleaching processes alter the chemical structures, with the loss of prismatic structure, with alteration of organic

components which on leading to decreased enamel bond strength²⁰

The incomplete removal of the partially denatured or destabilized collagen matrix has been proposed as a possible reason for compromised bond strength in sodium-hypochlorite-treated, acid-etched dentin¹⁴. Sodium hypochlorite, apart from being an effective deproteinizing agent. Sodium hypochloride is a potent oxidizing agent, use of this as an irrigant will cause the decrease of bond strength, if the decreased bond strength observed in sodium-hypochlorite and hydrogen-peroxide-treated etched dentin, then it is the result of the oxidizing action of these chemicals.

It may be possible for the compromised bond strength to be reversed by a reduction of the oxidized surfaces with a neutral, biocompatible anti-oxidant such as sodium ascorbate before resin bonding occurs¹⁵. Many others have suggested to wait for 1 week post bleaching before bonding for better result of composite adhesion²¹

The use of antioxidant has become versatile in the field of medicine in combating various diseases, the dietary supplementation of vitamin E may be effective in combating the neurodegenerative diseases, With initial large doses to build up tissue levels followed by the lessening of supplementation may be effective in both prevention and therapeutic efficacy of these vitamins. A high dose of vitamin E dietary supplementation or parenteral vitamin E administration¹¹

Vitamin E appears to be the first line of defense against peroxidation of PUFA present in cellular and subcellular membrane phospholipids¹¹. Vitamins E and C resulted in a decrease of various metabolic oxidative residues and were found more effective in combating stress induced pro-oxidant changes than pre-vitamin treatments⁹.

Lai SC et al and Kimyai S et al reported the effects of sodium ascorbate solution as an effective method to neutralize the accumulation of oxygen and its byproducts on the surface of enamel or dentin, improving bond strength and avoiding failures in adhesive resin polymerization^{28,29}.

Several studies has emphasized the use of antioxidant in the field of conservative dentistry, *Turkun et al* stated that the treatment of access cavities and pulp chambers with 10% sodium ascorbate solution following bleaching restores the sealing ability of resin composites^{9,25}

The use of solution form of antioxidant showed better results compared to hydrogel form²⁴. Only few studies have been done on the effective duration of application within the clinical conditions¹.

Increase in the time /concentration of antioxidants helps in removing the oxidative residues more in dentin than the enamel, leading to a better bonding properties²⁷, duration chosen is 10 minutes in this study to simulate the clinical working time and comfort of the patient. The effect of alpha tocopherol on the reversal of bond strength has not been researched extensively, therefore it has been chosen as a material of choice.

Alpha-tocopherol formulated in solution resulted in a significant increase in bond strength of bleached enamel²⁷

Kalili KT et al suggested pretreatment of enamel using dehydrating substances such as alcohol and acetone-containing adhesives to attain desirable results with regard to adhesion³⁰⁻³¹, therefore the solution used for preparing alpha tocopherol is chosen as ethyl alcohol.

The effective percentage value of antioxidants to neutralize the bleaching agents has not yet determined. 35% concentration of sodium ascorbate and alpha tocopherol is used so as to simulate the maximum effective delivery of antioxidants.

In this study the use of 35% sodium ascorbate and alpha tocopherol has shown to reduce the microleakage significantly on comparison to the group II where the restoration is delayed 1 week post bleaching.

Conclusion

Within the limitation of the study, tooth specimen treated with 35% alpha tocopherol and 35% sodium ascorbate solution before composite restoration showed significant reduction in the micro leakage when compared to immediate and delayed composite restoration after bleaching.

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