Effect of Bleaching on Microleakage of Resin Composite in Non Vital Teeth –In-Vitro Stereomicroscopic Study

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ABSTRACT

Introduction: Intra coronal bleaching is one of the most important treatment modality while treating discolored teeth. The factors resulting in discoloration of teeth may be intrinsic or extrinsic. Some of the factors responsible for extrinsic stains are tobacco, foods, beverages and chromogenic bacteria. These stains can be removed by oral prophylaxis, root planing or extracoronal bleaching. The aim of this present study was to evaluate the Microleakage in the Walking bleach procedure and to find out the effect of bleaching time on microleakage.

Material and Methods: Discoloration of endodontically treated teeth is an important concern for both patient and clinician. Walking bleach technique is one of the methods used to treat discolored teeth. Forty caries free human maxillary incisors extracted for periodontal reasons were obtained. Access cavity preparation was done using #2 round bur followed by Gates Glidden #2.

Results: The mean leakage values were lesser for group I and group II when compared to group III and group IV. The minimum mean leakage was recorded in group I is 0.580 and the maximum mean leakage was noted in group IV samples is 4.20.

Conlcusion: The conclusions drawn from the present study are bleaching time should be minimum and base is mandatory before the bleaching technique.

Keywords: Intra Coronal Bleaching, Walking bleach, Microleakage, Maxillary Teeth, Vital-Bleaching, Non-Vital Bleaching

INTRODUCTION

Esthetics plays a vital role in maintaining overall health and well being of an individual. Discoloration of teeth is a concern for both patient and the clinician. Intra coronal bleaching is one of the most important treatment modality while treating discolored teeth. The factors resulting in discoloration of teeth may be intrinsic or extrinsic. Some of the factors responsible for extrinsic stains are tobacco, foods, beverages and chromogenic bacteria. These stains can be removed by oral prophylaxis, root planing or extracoronal bleaching. The responsible factors for intrinsic stains are intra-pulpal hemorrhage, decomposition of pulp tissue in which breakdown products of blood, bacteria and proteins penetrate the dentinal tubules. The other causes include intra canal medicaments, obturation materials, systemic medications and metallic restorations placed in the access cavity. The basic techniques that have been used to treat staining of teeth are Thermo Catalytic technique and bleach technique. The primary difference between these two techniques is the way nascent oxygen is released from the bleaching agents. Bleaching procedures may be classified as Vital Bleaching and Non Vital Bleaching (Walking Bleach Technique).

The Walking bleach technique has become increasingly popular because it is both expedient and requires little chair time. This procedure was first reported by author Spasser in 1961 used sodium perborate and water to a thick paste which was sealed into the pulp chamber.[1] Nutting and Poe in 1963 substituted 30 percent hydrogen peroxide (Superoxol) for the water.[2] Because both sodium perborate and hydrogen peroxide release oxygen, since their combination could be synergistic and more effective. They named the technique as the "Walking bleach technique", because the bleaching occurs between appointments when the patient is not in dental office. After root canal treatment was done 2mm glass ionomer base was given prior to bleaching. Protective barriers such as poly carboxylate cement, zinc phosphate cement can also be used. Then the access cavity filling was done with the Z-100 (3M) composite resin after completion of bleaching procedure.

The aim of this present study was to evaluate the Microleakage in the Walking bleach procedure and to find out the effect of bleaching time on microleakage.

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MATERIAL AND METHODS

Discoloration of endodontically treated teeth is an important concern for both patient and clinician. Walking bleach technique is one of the methods used to treat discolored teeth. Forty caries free human maxillary incisors extracted for periodontal reasons were obtained from the Department Of Oral And Maxillofacial Surgery, Government Dental College And Hospital, Hyderabad and stored in normal saline until further use. Access cavity preparation was done using #2 round bur followed by Gates Glidden #2. The canal length was established by placing a #15 file into each root canal until the tip was visible at the apical foramen. The working length was established 1mm short of the apex. The teeth were instrumented to the working length with frequent irrigation to size # 40file using step back technique.The obturation is done in all the teeth by lateral condensation method. The excess gutta percha was sheared up to the canal orifice and then 2mm gutta percha was removed with a warm finger plugger and 2 mm Glass ionomer base was placed over gutta percha.

All the forty teeth were then divided into four groups of ten teeth each as follows:

Group I: Cotton pellets were placed into pulp chamber of ten teeth and sealed with cavity (ESPE – Premier) for seven days without any bleaching.

Group II: Mixture of walking bleach (Mixture of 30% Hydrogen Peroxide and Sodium perborate) was placed in the pulp chamber and sealed with cavit (ESPE – Premier) for two days.

Group III: Mixture of walking bleach (Mixture of 30% Hydrogen Peroxide and Sodium perborate) was placed in the pulp chamber and sealed with cavit (ESPE – Premier) and bleached for four days.

Group IV: Mixture of walking bleach (Mixture of 30% Hydrogen Peroxide and Sodium perborate) was placed in the pulp chamber and sealed with cavit and bleached for seven days.

After the prescribed time cavit and bleaching materials were removed from the pulp chamber and then cavities were rinsed with saline and dried. The cavities were then restored with Z-100 (3M) composite resin at the end of bleaching procedures. All the four group samples were subjected to thermo cycling at 5°C -60°C for 2 hours at one minute interval in each water bath. All the teeth were then subjected to dye leakage test. All of the teeth were coated with two coats of nail polish except the access cavities and 1mm around them. The root apices were sealed with modeling wax. These specimens were then immersed incisional end down in 50% Silver nitrate for 2 hours. After staining teeth were washed in tap water, nail polish and modeling wax were removed with a scalpel. The teeth were sectioned longitudinally by using a diamond disc. The sections were made from buccal to lingual through the centre of the coronal restoration and root canal filling.The prepared specimens are viewed under Stereo microscope at a magnification of 25 x.

S.N.	Group I	Group II	Group III	Group IV
1	0.2	0.3	2.4	5.0
2	0.8	1.2	1.6	4.2
3	0.8	0.5	3.7	3.2
4	0.4	0.7	2.8	4.5
5	0.3	1.0	1.9	6.5
6	0.8	0.5	2.3	3.5
7	0.2	0.4	3.2	4.6
8	0.4	0.8	1.6	3.6
9	0.7	0.6	1.8	4.2
10	1.2	0.9	2.3	2.7
Total	5.8	6.9	23.6	42.0

Table-1: Dye penetration in different specimens (mm)

RESULTS

In the present study, 40 freshly extracted single canal maxillary incisors were selected from the Dept. of Oral and Maxillofacial Surgery, Government Dental College and Hospital, Hyderabad. The teeth were cleaned, scaling was done for all the teeth and teeth were placed in normal saline in a glass beaker. The samples were then divided into 4 groups, Group I specimens which were not bleached for 7 days, Group II specimens were bleached for 2 days, Group III specimens were teeth were bleached for 4 days, Group IV specimens were bleached for 7 days. Access cavities were restored with composite resin. Silver nitrate dye was

Groups	Number of specimens	Mean	Standard Deviation	Lower Bound	Upper Bound	Minimum	Maximum
I	10	0.580	0.329	0.1475	1.012	0.200	1.20
II	10	0.690	0.285	0.2575	1.122	0.300	1.20
III	10	2.36	0.698	1.928	2.792	1.60	3.70
IV	10	4.20	1.07	3.768	4.632	2.70	6.50
	40	7.82	2.38	6.100	9.55	4.8	12.59

Table-2: Mean and standard deviation values of dye penetration of different experimental groups

Source	Sum of squares	Degree of Freedom	Mean sum of squares	"F" value
Between groups	86.95	3	28.98	63.74
Within groups	16.37	36	6.4547	
Total	103.3	39		

Table-3: Analysis of variance (ANOVA)

used for dye penetration test. The longitudinal sections were evaluated under Stereomicroscope for the measurement of dye penetration.

Table 1 and Figure 1 represents the leakage values of all groups of samples after immersion in Silver nitrate dye for 2 hours

Table 2 shows the mean leakage values of different experimental groups and Standard Deviation. It is seen that the mean leakage values were lesser for group I and group II when compared to group III and group IV

The minimum mean leakage was recorded in group I is 0.580 and the maximum mean leakage was noted in group IV samples is 4.20. This table shows minimum and maximum leakage of different groups.

Table 3 shows the results of Analysis of Variance of the experimental groups. The "F" Value was calculated by the following method.

$$\mathbf{F} = \frac{\text{Between groups variation}}{\text{Within a group variation}}$$

Here the "F" value is 63.74 which indicates the significant difference between groups (<0.05).

Table 4 and Figure 2 shows the frequency and percentage of dye penetration in different experimental groups.

Table 5 shows dye penetration among each one of the group, 't' test shows there was not much difference between Group I and Group II, where as there was,

- Clinically significant difference exists between Group I and III ($p< 0.05$)
- Clinically significant difference exists between Group I and IV ($p< 0.05$)
- Clinically significant difference exists between Group III and IV ($p< 0.05$)
- Clinically Significant difference exists between Group II and III($p< 0.05$)
- Clinically Significant difference exists between Group II and IV($p< 0.05$)

Figure 3-7 shows various tooth specimens in dye.

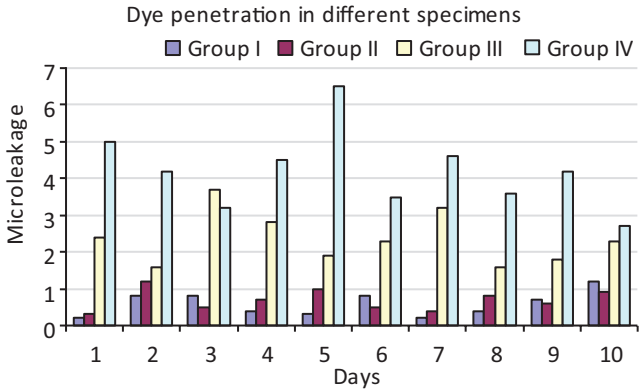

Figure-1: Dye penetration in different specimens

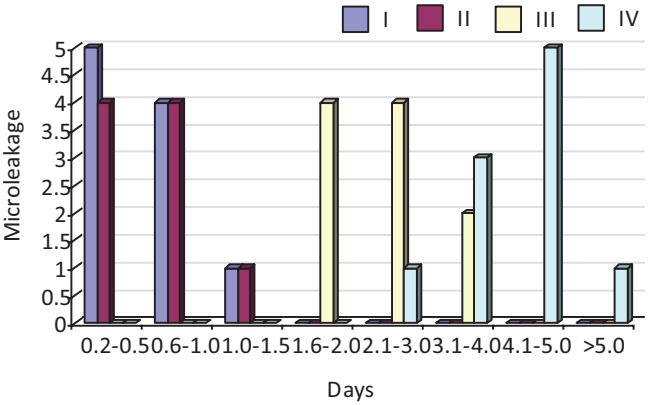

Figure-2: Frequency and percentage distribution of dye penetration in different groups

Leakage Interval	Group I		Group II		Group III		Group IV	
0-0.5	5	50%	4	40%				
0.6-1.0	4	40%	5	50%				
1.1-1.5	1	10%	1	10%				
1.6-2.0					4	40%		
2.1-2.5					3	30%		
2.6 -3.0					1	10%	1	10%
3.1-3.5					1	10%	2	20%
3.6-4.0					1	10%	1	10%
4.1-4.5							2	20%
4.6-5.0							3	30%
>5.0							1	10%

Table-4: Frequency and percentage distribution of dye penetration

Groups	Degrees of Freedom	T-Value	P-Value	Inference
Group I & II	18	-.799	0.435	Not Significant
Group I & III	18	-7.29	0.013(<0.05)	Significant
Group I & IV	18	-10.2	0.001(>0.05)	Significant
Group III & IV	18	-4.56	0.034(>0.05)	Significant
Group II & III	18	7.01	0.001(<0.05)	Significant
Group II & IV	18	10.0	0.003(<0.05)	Significant

Table-5: Paired t-test values

Figure-3: Photograph showing anterior maxillary specimens

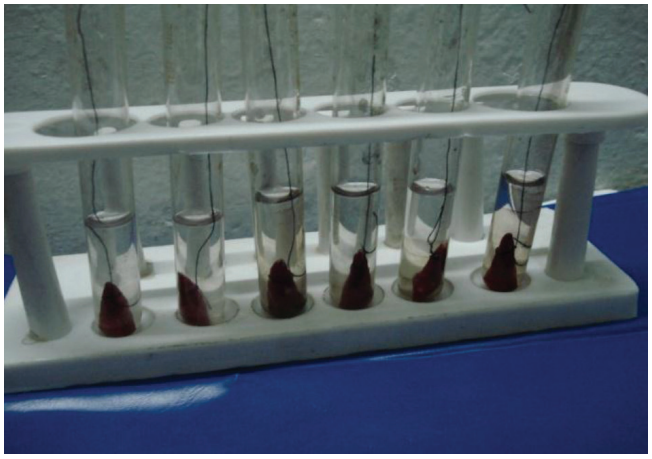

Figure-4: Photograph showing group 1 specimen placed incisal side down in dye

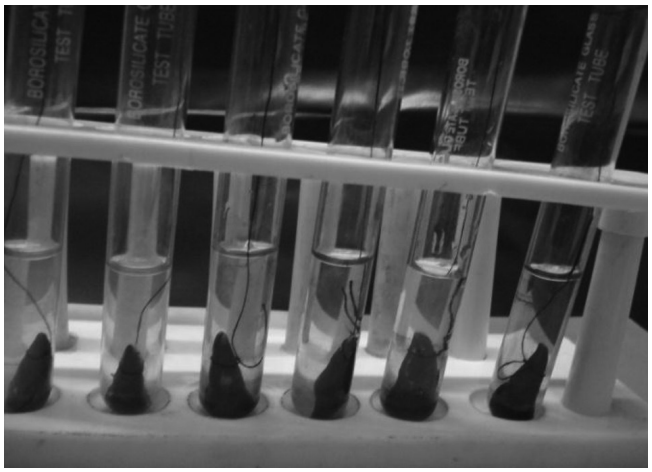

Figure-5: Photograph showing group 2 specimens placed incisal side down in dye

DISCUSSION

Esthetics plays a vital role in maintaining overall health and well being of an individual. Discoloration of teeth is a concern for both patient and the clinician. Walking bleaching is one of the most important treatment modality for the treatment of discolored teeth. Bleaching is defined as "the process of lightening the colour of a tooth through application of a chemical agent to oxidize the organic pigmentation on the tooth". Bleaching of Root Canal treated teeth is performed before the placement of esthetic restoration. Bleaching of non vital tooth leading to micro leakage can impair long-term success of both bleaching procedure and Root Canal therapy.

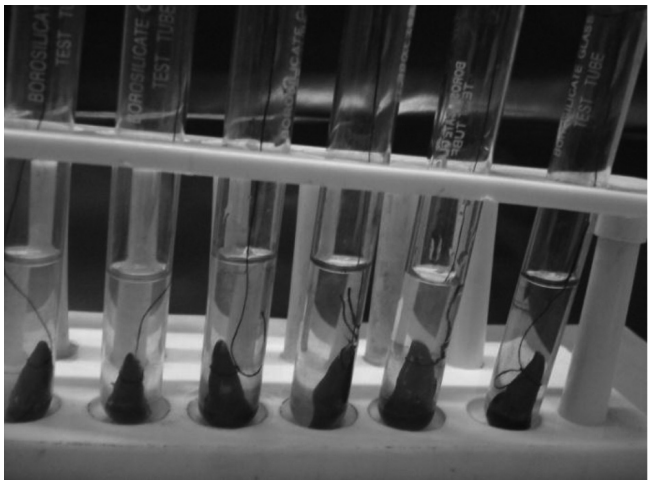

Figure-6: Photograph showing group 3 specimens placed incisal side down in dye

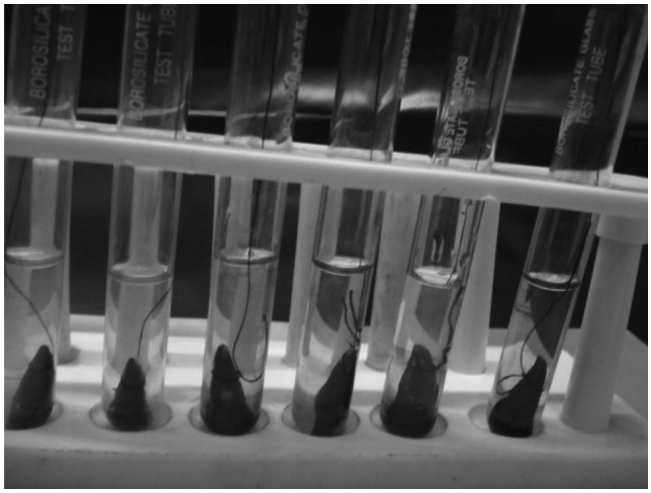

Figure-7: Photograph showing group 4 specimens placed incisal side down in dye

In the present study the effect of walking bleach technique and its duration regimen on the micro leakage along the tooth and filling material interface was studied.

For this forty caries free human maxillary incisors were selected. Access cavities were prepared and working length was established 1 mm short of apex. All samples were instrumented to size # 40 K- file using step back technique. Obturation was done in all teeth by lateral condensation. The 2 mm gutta percha was removed with warm finger plugger and then 2 mm of glass ionomer cement base was placed below Cemento Enamel Junction.

Kehoe in his study demonstrated that walking bleach placed below Cemento Enamel Junction without any protective base could lead to penetration of bleaching agent along the patent dentinal tubules contributing to external root resorption of the tooth.[3] Because in the present study 2 mm glass ionomer cement base was placed before the bleaching procedure.

J. Smith et al indicated that 2mm of base over the gutta percha would reduce both linear leakage and dentinal

penetration of the dye and also suggested that placement of a dye is mandatory in Walking bleach technique.[4] In the present study also 2 mm glass ionomer base was placed.

Another study done by Demarco et al in which microleakage was observed at the tooth resin interface. This study correlates with the present study in which microleakage was observed at tooth resin interface.[5] Whereas Grossman in his Text Book "Endodontic Practice" (1988 edition) has described to seal the root canal orifice with at least 1mm of cavit over gutta percha to prevent penetration of bleaching agent into the apical area. But in the present study 2mm. Glass Ionomer Cement base was placed.[6]

Ludovic et al recommended that a base should be used to protect the dentine tubules near the gingival attachment during bleaching. Because 2mm glass ionomer cement base was placed over the Gutta percha in the present study.

Sherwood and Laxminarayana in their study used a minimum thickness of 5mm as base over gutta percha required to prevent penetration of bleaching agent into the dentinal tubules. But in the present study 2mm. Glass Ionomer Cement base was placed over the Gutta percha to minimize the micro leakage.[7]

Montgomery suggested placing a Cavit base leaving the root canal filling at more coronal level so that bleaching agents would be completely restricted to the pulp chamber minimizing the micro leakage.[8] In the present study also 2mm.Glass Ionomer Cement base was placed over the Gutta percha to minimize the microleakage.

In the present study forty specimens were taken and divided into four groups.

Group I (control group): Plain cotton pellet sealed in the pulp chamber with Cavit for 7 days.

Group II: mixture of walking bleach (30% Hydrogen Peroxide and Sodium Perborate) was placed in pulp chamber and sealed with Cavit for 2 days.

Group III: mixture of walking bleach (30% Hydrogen Peroxide and Sodium Perborate) was placed in pulp chamber and sealed with Cavit for 4 days.

Group IV: mixture of walking bleach (30% Hydrogen Peroxide and Sodium Perborate) was placed in pulp chamber and sealed with cavit for 7 days.

From all the specimens' cavit and bleaching materials were removed from the pulp chamber and then cavities were rinsed with saline and air dried. The cavities were then restored with Z-100 (3M) composite resin. All the teeth were immersed in silver nitrate dye for two hours and then sectioned longitudinally. The specimens were then viewed under Stereomicroscope (25 x magnification). It is seen that the mean leakage values of group I is 0.58mm, group II is 0.69 mm, group III is 2.3mm and group IV is 4.2 mm. This indicates that by increasing the duration of bleaching period microleakage increased.

This is in accordance with study done by Iian Rotstein et al, where teeth were subjected to bleaching for periods of 15min, 1 hour, 1 day and 3 days. The amount of penetration into the dentinal tubules was measured.[9] It was found that by increasing the duration of bleaching period, penetration into dentinal tubules substantially increased. In the present study Group I maintained as Control Group and bleaching was done for 2days for Group II, 4days for Group III and 7days for Group IV. In the present study also it was found that increasing the duration of the bleaching time dye penetration into the dentinal tubules was increased.

Study done by Turssi et al, evaluated the effect of non vital tooth bleaching on micro leakage of composite resin interface at different post bleaching times 7 days, 14 days and 21 days. They stated that at 14 days and 21 days there was no difference among groups, but residual peroxide or water may affect the sealing ability of composite resin restorations performed up to 7 days after bleaching procedures.[10] In the present study Group I was maintained as Control Group while bleaching was done for 2 days for Group II, 4 days for Group III, 7 days for Group IV. And the effect of Walking bleaching on micro leakage of Tooth Resin interface was observed at post bleaching times 2 days, 4 days and 7 days. It was found that there was no significant difference between Group I and Group II, but there was clinically significant difference between Group III and Group IV.

According to Turkun et al, the effect of non-vital bleaching on the sealing ability of Resin Composite Restorations. They stated that non vital bleaching adversely affected the immediate sealing ability of resin composite restorations and 1 week delay in restoration following bleaching improved the sealing ability of Resin Composite.[11]

In the present study also there was significant effect of Walking bleaching on the sealing ability of Resin Composite and micro leakage was observed along tooth and composite material interface. This is supported by study of Turkun et al in which non-vital bleaching affected the immediate sealing ability of resin restorations.[11]

According to Rotstein et al, specimens were bleached with 30% hydrogen peroxide for periods of 5min, 20min 40min and 60min and radicular penetration was found.[9] They have suggested that when hydrogen peroxide is used as oxidizing agent the bleaching time should be minimum. This indicates there is a significant increase in micro leakage with increase in duration of walking bleach technique.

In the present study also specimens were bleached with Hydrogen peroxide for periods of 2 days for Group II, 4 days for Group III and 7 days for Group IV and dye penetration was observed at tooth resin interface which was increased with the increased in bleaching period.

CONCLUSION

The conclusions drawn from the present study are bleaching time should be minimum and base is mandatory before the bleaching technique.

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