EVALUATION OF THE LEAKAGE OF BLEACHING MATERIALS THROUGH DIFFERENT BASES INTO THE ROOT CANAL FILLING: AN INVITRO STUDY

ABSTRACT

AIM: The purpose of this study was to evaluate the leakage of bleaching agents through 3 different bases into the obturated pulp space and dentinal tubules in intra coronal bleaching. **MATERIAL AND METHODS:** Fifty-five freshly extracted, intact non-carious single rooted teeth were collected and stored in formalin until used. The specimen divided into experimental and control group. Experimental group were further subdivided into 3 subgroups on the base of cervical base materials. Group I was Type II GIC, Group II was Fuji II LC and Group III was Hybrid composite. The control groups was divides into negative group (received the bleaching agent and received complete external coating including access cavity) and positive control group (did not receive any external coating). The obturated pulp space were removed at a level of 3 mm below the cemento enamel junction and filled with dry cotton pellets and temporized with temporary cement, stored at ± 37°C and 100% relative humidity for five days, the bleaching material were placed in the pulp chamber (a paste of sodium perborate i.e. 0.15g and 30% hydrogen peroxide 0.05ml), and then stored for 3 days in an incubator. Later on the teeth were immersed in India ink dye and stored at ± 37°C and 100% relative humidity for 5 days. Specimens were examined under binocular microscope with a stage micrometer to analyze the degree of dye penetration. **RESULTS:** The minimal leakage values were observed with type II glass ionomer cement followed by light cure glass ionomer cement and lastly by hybrid composite. **CONCLUSION:** The present invitro investigation evaluated the microleakage observed with different cervical base materials during non-vital bleaching procedures.

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KEYWORDS

Bleaching materials. GIC- II. Fuji-II LC. Hybrid composite. Dye penetration.

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INTRODUCTION

Beauty is a combination of qualities that gives pleasure to the senses especially the eyes as the old adage says "beauty lies in the eyes of the beholder". Patients with discoloured teeth presents a difficult clinical situation for a clinician and also the challenges in correcting the situation. Staining of discoloured teeth can be intrinsic or extrinsic, pre eruption or post eruption usually from various natural or iatrogenic causes.[1] Cosmetic dentistry has focused on tooth whitening in the past few years.

The intracoronal bleaching procedure is largely used as tooth whitening procedure because of his efficiency, simplicity and economics as compared to the prosthetic treatment.[2] Bleaching has stood the test of times and not only proved to be the least invasive and economical but also effective. According to Sturdvent[3] bleaching is the "lightening of colour of tooth through application of chemical agents to oxidize organic pigmentation of tooth". Non vital tooth bleaching have shown to be an effective and conservative technique.

The walking bleach technique is a traditional method in bleaching the endodontically treated tooth. Intracoronal bleaching technique is usually associated with two commonly causitic chemicals,30-35% hydrogen peroxide (H_2O_2) that is a primary oxidizing agent and sodium perborate ,where both would release oxygen. Their combination would be synergistic and more effective.[1,2]

The main concern of the dentist while performing the intra coronal bleaching procedure is the possibility of external cervical resorption.[4,5] Different techniques and materials have been tested in order to eliminate the resorption. Different types of protective barriers like (RMGI), conventional Glass Ionomer Cement, light cured Calcium hydroxide cement, Mineral trioxide Aggregate (MTA) are placed to prevent leakage and penetration of bleaching agent into the periodontal ligament space. Unfortunately this restorative base placed over the gutta percha reduces the diffusion but also prevent it.[6]

The purpose of this study was to evaluate the leakage of bleaching agents through three different phases into the obturated pulp space and dentinal tubules in intra coronal bleaching.

MATERIAL AND METHODS

Fifty five freshly extracted ,intact non carious and unrestored human single tooth were collected and stored in formalin until used.After cleaning the tooth of all calculus and surface deposits,the selected specimens were used within a month of extraction and storage. The specimen divided into experimental and control group. Experimental group were further subdivided into 3 groups on the base of cervical base materials. Group I was Type II

GIC, Group II was Fuji II L C and Group III was Hybrid composite. Control Groups were divided into negative and positive control groups (Table 1).

Table 1. Number of specimens in each group.

GROUP	NO. OF SPECIMENS	CERVICAL BASE
I	15	Type II glass ionomer cement
II	15	light cure glass ionomer cement (RMGIC)
III	15	Hybrid Composite (Including bonding agent)
IV	5	Positive Control (Obturated with Gutta-Percha Cones but no sealer used)
V	5	Negative Control (Obturated with Gutta-Percha Cones along with Sealer)

Access cavity preparation were made on the palatal surfaces of each tooth using a high speed rotary hand piece with an endo access bur (Figure 1). Necrotic pulp tissue was removed with a barbed broach .Number K-10 file was placed in the canal to establish the patency of the foramen. The root canals were prepared 1 mm short of apex. The instrumentation of the canals involve circumferential filing. During debridement process copious amount of 1% sodium hypochlorite and normal saline were alternatively used to irrigate the canal between the changes in the file size. Canals were cleaned and dried with absorbent paper points and obturated with gutta percha.

The obturated pulp space were removed at a level of 3 mm below the cemento enamel junction; followed by the placement of one of the three cervical base materials.

The specimens received the bleaching material in the pulp chamber (a paste of sodium perborate i.e. 0.15g and 30% hydrogen peroxide 0.05ml), followed by the temporization of the access cavity, and then stored at a temperature of ± 37°C and 100% relative humidity for 3 days in an incubator. This bleaching procedure was repeated 3 times.

Figure 1. Showing access cavity preprations.

Each tooth received an external coating with two layer of nail varnish and a thick layer of sticky wax except for the access opening, and later the teeth were immersed in India ink dye and then placed in a vaccum pump for 30 minutes, and once again immersed in India ink

stored at ± 37°C and 100% relative humidity for 5 days (Figure 2).

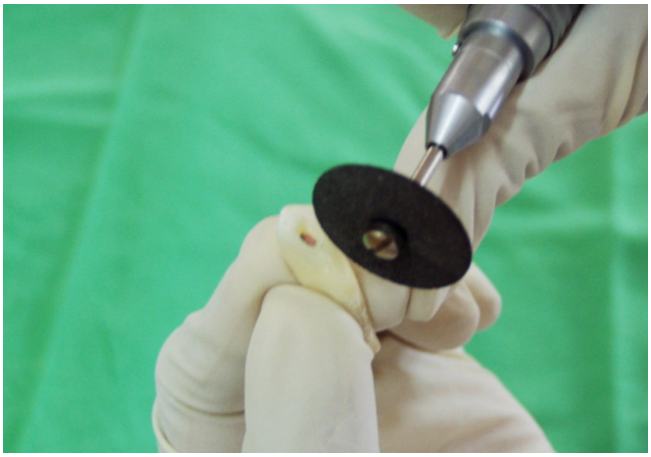
Figure 2. Specimens immersed in Indla ink.

The obturated pulp space materials were removed at a level of 3 mm below the cementoenamel junction, received the bleaching agent and complete external coating ,which served as a negative control group containing five specimens.

In positive control group, the obturation was done only with gutta percha and no zinc oxide eugenol sealer was used,where 3 mm of gutta percha was removed at a level of the cement enamel junction but did not receive any external coating containing five specimens.

Specimens were sectioned (Figure 3) and examined under binocular microscope with a stage micrometer to analyze the degree of dye penetration with the walking bleaching technique (Figure 4 to 8). The degree of dye penetration is graded as 0- no leakage, 1- 0.1mm to 0.5 mm leakage, 2- 0.6-1mm leakage , 3- 1.1mm to 2 mm leakage ,4- 2.1mm to outer root surface leakage.

Figure 3. Showing sectioning of specimen.



RESULTS

The statistical analysis was done using ANOVA (Fisher's Test).

A comparison was done between the groups by using Tukey's test. Probability of 0.05 to be taken as significant. Analysis was done using statistical package SPSS 14.0.

Figure 4. Photograph showing dye penetration in experimental group with Type 2 GIC as cervical base.

Figure 5. Photograph showing dye penetration in experimental group with LC GIC .

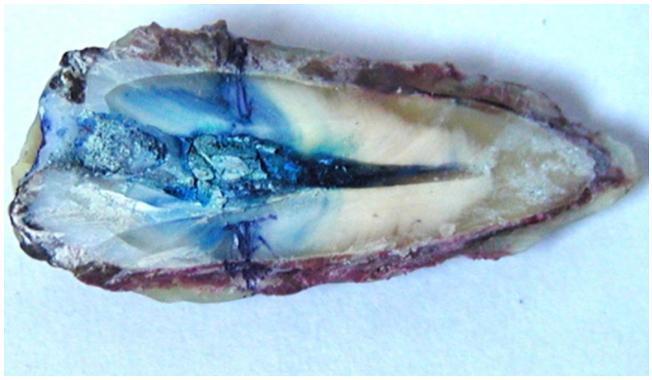


Figure 6. Photograph showing dye penetration in experimental group with hybrid composite as cervical base.

Figure 7. Photograph showing dye penetration in positive control group.

Table 2 shows the Individual scores in apical direction , Group III (Hybrid composite) shows highest value leakage of dye, Group II (GIC LC) shows lower value leakage of dye than Group III (Hybrid composite) and Group I (Type II GIC) has the least value of leakage of the dye.

Figure 8. Photograph showing dye penetration in negative control group.

Table 3 shows individual scores are their mean in apical dye penetration using Tukey's test. Group III (Hybrid composite) shows highest value leakage of dye. Group II (GIC LC) shows lower value leakage of dye than Group III (Hybrid composite), and Group I (Type II GIC) the least value of leakage of the dye (Figure 9).

Table 4 shows comparison between the inter groups in apical dye penetration using Tukey's test. A comparison of group I (Type II GIC) was done with group II (GIC LC) where group II showed more leakage than group I which is statistically very highly significant (Figure 10).

A comparison of group I (Type II GIC) was done with group III (Hybrid composite) where group I showed lesser leakage than

group III which also is statistically very highly significant.

A comparison of group II (GIC LC) was done with group III (Hybrid composite), even though group III showed more leakage than group II but statistically not significant.

Table 2. Individual scores recorded in dye penetration leakage in an apical direction.

SUBJECTS	SCORES		
	GROUP I	GROUP II	GROUP III
1	42.50	102.50	142.50
2	55.00	175.00	105.00
3	60.00	120.00	145.00
4	50.00	130.00	132.50
5	40.00	97.50	150.00
6	50.00	140.00	110.00
7	38.00	120.00	130.00
8	62.00	130.00	110.00
9	55.00	165.00	155.00
10	42.00	175.00	160.00
11	48.00	105.00	170.00
12	45.00	125.00	140.00
13	53.00	99.50	155.00
14	48.00	120.00	120.00
15	44.00	140.00	138.00
MEAN	48.83	129.63	137.53
STANDARD DEVIATION	7.15	25.59	19.59

Table 3. Individual scores are their mean in apical dye penetration.

Group I (Type II GIC)	48.83 ± 7.15
Group II (GIC LC)	129.63 ± 25.59
Group III (Hybrid composite)	137.53 ± 19.59

Figure 9. Comparison of mean apical dye leakage.

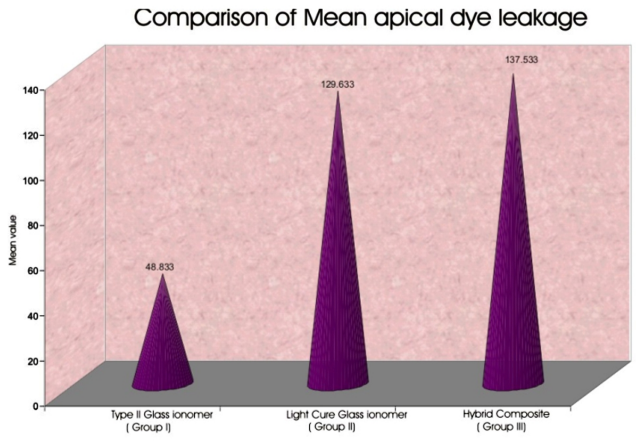


Figure 10. Comparison of mean lateral dye leakage.

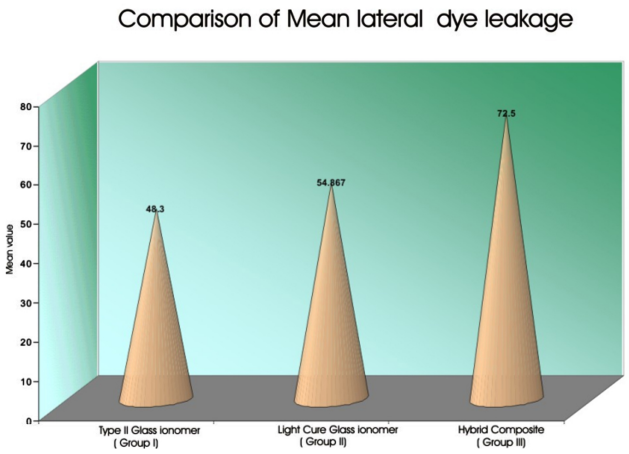


Table 4. Comparison between the inter groups in apical dye penetration.

COMPARING GROUPS	P SIGNIFICANCE	INFERENCE
I to II	<. 0001	Very Highly Significant
I to III	<. 0001	- Do-
II to III	.498	Not Significant

Table 5 shows the individual scores recorded in dye penetration leakage in a lateral direction. Group III has the highest value of leakage of lateral leakage followed by group II, and group has the least value of leakage. Table 6 shows comparison between the groups in lateral dye penetration using Tukey's test.

A comparison of group I (Type II GIC) was done with group II (GIC LC), where group I showed less leakage than group II which is statistically not significant.

A comparison of group I (Type II GIC) was done with group III (Hybrid composite) where group III showed more leakage than group I which is very highly significant statistically. A comparison of group II (GIC LC) was done with group III (Hybrid composite) where group II showed lesser leakage than group III, which is statistically highly significant.

DISCUSSION

The discoloration of endodontically treated teeth may result from several factors such as necrotic pulp tissue and endodontic filling materials left in the pulp chamber, haemorrhage following trauma and some medicaments. These residues together with bacteria and other proteins may disseminate into the dentinal tubules causing tooth discoloration[7]. Some studies suggested that mixing of sodium perborate with 30-35% hydrogen peroxide to enhance the bleaching effects, hence this method was referred to as the walking bleach method and it was believed that the combination of these two oxidizing agents would be synergistic and more effective.[5,6,7,8] To this date this walking bleach method has become the most widely used nonvital bleaching technique because of its simplicity, inexpensiveness and reliable bleaching efficiency.

Intracoronal bleaching technique recommends removal of guttapercha 3mm apical to the cemento enamel junction allowing the bleaching agent to diffuse incisally to lighten the cervical 3rd of the crown. The combination of bleaching agents placed below cemento enamel junction and a potential defect at the cemento enamel junction may allow the bleaching agent to leach through the patent dentinal tubules into the periodontal ligament space below the epithelial attachment. An inflammatory reaction ensues that can cause external root resorption at the cervical level.[9,10]

Based on the results, of the three above mentioned materials namely hybrid composite

showed higher value of leakage followed by light cure glass ionomer cement and type II glass ionomer cement showed least value of leakage.

Review of the available literature on hybrid composite have shown that prior treatment of the tooth surface like acid etching with 37% phosphoric acid aids in the removal of smear layer exposing the dentinal tubules.[11] The opening of the dentinal tubules could be a factor in aiding leakage. Development of internal stresses from polymerization shrinkage and thermal effects also has detrimental effects on the bond; hence microleakage is a serious problem.[12]

Another factor that may play a role is the coefficient of thermal expansion of the material. The marginal integrity depends on the difference between the coefficient of thermal expansion of the resin composites and the tooth structure. Studies show that, in general, resin composites with low filler volumes have higher coefficients of thermal expansion. Thomas Attin et al.[12] conducted a study to evaluate on initial curing shrinkage and volumetric change of six resin modified glass ionomer cements, hybrid composite and chemical cured glass ionomer cement and concluded that curing shrinkage of resin modified glass ionomers were greater than hybrid composite and a conventional glass ionomer.

Table 5. Individual scores recorded in dye penetration leakage in a lateral direction.

SUBJECTS	SCORES		
	GROUP I	GROUP II	GROUP III
1	40.00	50.00	70.00
2	52.50	65.00	55.00
3	75.00	35.00	80.00
4	35.00	80.00	70.00
5	38.50	35.00	92.50
6	52.50	65.00	55.00
7	40.50	35.00	60.00
8	63.50	80.00	60.00
9	52.00	75.00	90.00
10	38.50	70.00	85.00
11	50.00	55.00	90.00
12	47.50	40.00	75.00
13	50.50	38.00	65.00
14	46.50	35.00	65.00
15	42.00	65.00	75.00
MEAN	48.30	54.87	72.50
STANDARD DEVIATION	10.49	17.55	12.78

Table 6. Inter comparison between the groups in lateral dye penetration.

COMPARING GROUPS	P SIGNIFICANCE	INFERENCE
I to II	.408	Not Significant.
I to III	<. 001	Very Highly Significant
II to III	.003	Highly Significant

Barkhordar et al.[13] in their study undertook to assess the effect of non-vital tooth bleaching on the microleakage at the tooth – resin composite interface, showed that bleaching has deleterious effect on the tooth – resin composite interface. In this study, hybrid composite as a cervical base demonstrated high leakage in comparison with type II glass ionomers which is in concurrence with the above quoted studies. Light cure glass ionomer cements (RMGIC) performed slightly better than hybrid composite , whereas conventional glass ionomer showed the least leakage.

Light cure glass ionomers have occasionally shown increased levels of microleakage compared to the conventional glass ionomers. This is probably because of the light cure component in the former that causes polymerization shrinkage[14]. Moreover, less water and less carboxylic acid content also decreases the wetting ability of light cure glass ionomer cements to the tooth substance promoting marginal leakage.

The coefficient of thermal expansion for glass-ionomer cements is close to that of enamel and its thermal diffusivity is low. For this reason, micro leakage at the tooth/cement interface is minimal compared with other direct restorative materials.[15]

The principal obstacle to effective adhesion to dental tissue is moisture contamination. Moisture will compete with a potential adhesive for the surface of the substrate and can also hydrolyse adhesive bonds. Glass-ionomer cement is a highly ionic polymer that can compete successfully with moisture because of the multiplicity of carboxyl groups that can form strong hydrogen bonds to apatite.[15,16]

Oliveria et al.[17] in their study have pointed out the importance of a cervical base or barrier in non-vital bleaching. As per their results, resin modified glass ionomer cement showed slightly less leakage than conventional glass ionomer which is statistically not highly significant. Takeohara et al.[17] in one of the studies used resin modified glass ionomer cement as a cervical base followed by bleaching with sodium perboratetetrahydrate with water. Two years later radiographic assessment revealed no evidence of external cervical resorption hence the assumption that resin modified glass ionomer cement is a good choice as a cervical base. Though the author did not compare resin modified glass ionomer cement with conventional glass ionomer cement as done. Acording to our study type II glass ionomer cement showed the least leakage

than light cure glass ionomer cement. When comparing to the study above, it could be due to the fact that the bleaching agent used was sodium perboratetetrahydrate with water which is least invasive than 30-35% hydrogen peroxide mixed with sodium perborate which is known to be more potent bleaching agent, caustic and highly invasive.[18,19,20] On comparison, light cure glass ionomer cement (RMGIC) in group II demonstrated slightly less leakage to hybrid composite in group III in this study. This could be due to the fact that, in the case of light cure glass ionomer cement (RMGIC), placement of the cement is after conditioning of dentin where there is an alteration of the dentin surface including the smear layer. In other words it modifies the smear layer. Conditioning would increase or decrease the thickness and morphology of smear layer and also the tubules.[3. 14]

Based on our study it found that type II conventional glass ionomer cement is an excellent material as a cervical base which could prove to be a better alternative than light cure glass ionomer cement and hybrid composites. Placement of a barrier over the gutta-percha certainly enhances the seal, if not prevent, at least would minimize the leakage of the bleaching materials.[7]

CONCLUSION

The present in vitro investigation evaluated the microleakage observed with different cervical base materials during non-vital bleaching procedures.

From this study we can conclude that The minimal leakage values were observed with type II glass ionomer cement followed by light cure glass ionomer cement and lastly by hybrid composite.

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