RADICULAR PENETRATION OF HYDROGEN PEROXIDE FROM VARIOUS INTRACORONAL BLEACHING AGENTS: AN VITRO STUDY

Sharma D. S.,* Sharma S.**

External cervical resorption has been reported to occur when bleaching of root filled teeth is done with 30% H_2O_2 alone or mixed with sodium perborate. H_2O_2 leakage through dentinal tubules has been speculated as one of the reasons for the resorption. External cervical root resorption has not been reported with the bleaching agent sodium perborate mixed with bidistilled water. Purpose of this study was to comparatively evaluate the H_2O_2 leakage from three bleaching agents i.e. sodiumperborate mixed with 30% H_2O_2 or bidistilled water or 30% H_2O_2 alone.

21 human freshly extracted premolars were taken and root canal treatment was completed. Pulp chambers were prepared to receive bleaching agents. The teeth were divided into experimental and control groups. Experimental group was again divided into subgroups : A, B, C according to bleaching agents used. Results showed that maximum H_2O_2 leakage occurred from 30 % H_2O_2 while minimum from sodium perborate mixed with bidistilled water.

KEY WORDS: Hydrogen peroxide, Radicular penetration, Intracoronal Bleaching

INTRODUCTION

Despite of all technico – scientifical evolution and care that must be taken during an endodontic treatment, there is a great number of teeth that change colour after this procedure. These cases and non-vital discoloured root canal treated teeth are treated with intra- coronal bleaching. Thirty percent hydrogen peroxide alone or with sodium perborate has been used successfully for bleaching of discolored root-filled teeth[1,2,3]. But these bleaching agents often have been reported to be associated with external cervical resorption[4,5]. It was speculated that hydrogen peroxide released by these bleaching agents diffuse through radicular dentin into the periodontal ligament, which may be followed by inflammatory process. This may initiate external cervical root resorption[4]. Rotstein et al. confirmed this hypothesis using 30%. H_2O_2 as a bleaching agent[6]. Concentrated hydrogen peroxide effects the surface morphology of tooth enamel and inorganic components of human dentine and cements [7,8]. These changes may increase the microleakage of composite resin to the bleached tooth surface [9]. Robert A. Floyd [10] considered that the tissue's susceptibility to oxidative stress damage depends not only on the magnitude of the applied oxidative stress, but also on the anti-oxidant status of the tissue per se and possibly on the age of person. He suggested the prudent use of peroxides in dentistry as it is dealt with living tissues. The bleaching reaction should cause minimal oxidative stress on already stressed tissues due to aerobic metabolism so that oxygen free radicals can be scavenged by natural body mechanism viz. SOD (superoxide dismutase), catalase and peroxidase etc. Hence it is suggested that the bleaching agent should be as milder as can be yet clinically successful.

A hypothesis was made that there should be less leakage of hydrogen peroxide from sodium perborate mixed with water as compared to other bleaching agents used in this study.

The objective of this study was to compare the radicular penetration of hydrogen peroxide from

*Associate Professor
**MDS Student, Department of Pedodontics with Preventive Dentistry, Modern Dental College & Research Center, Indore, M.P., India.

three intra-coronal bleaching agent i.e. 30% hydrogen peroxide, sodium perborate mixed with 30% hydrogen peroxide and sodium perborate mixed with bidistilled water.

MATERIAL AND METHODS

Twenty one intact single rooted human teeth freshly extracted for orthodontic reason were used in this study. All the teeth were placed in 5.25% sodium hypochlorite for one hour in order to remove soft tissues on root surface. Hard deposits were removed manually by scaling. Teeth were then stored in 0.9% physiological saline. Lingual access was prepared and each root canal was cleaned and shaped using step-back and circumferential technique. This was followed by obturation with gutta-percha and zinc-oxide eugenol sealer using lateral condensation technique. Gutta-percha filling was removed 3 mm short of cemento-enamel junction (CEJ) level using hot-pluggers. Remnants of gutta-percha and sealer were removed with slowly rotating carbide bur and then with the help of cotton soaked in chloroform. Pulp chamber was then cleaned with bidistilled water.

The teeth were now divided into control and experimental groups. Experimental group was again subdivided into three subgroups according to various bleaching agents used in this study. The control group consisted of 6 teeth while the experimental group consisted of 15 teeth. Same 15 teeth were used repeatedly for each group in order to make direct comparison of H_2o_2 leakage from three bleaching agents. (Table-1) Bidistilled water was pipetted into the pulp chamber of control group.

All teeth were mounted in plastic tubes of 3.5 ml capacity. The cap of each tube was perforated and crown of each tooth was mounted into cap with the help of sticky wax in a manner to separate crown from the root at a level 1 mm above the mesial and distal line of CEJ. The root of each sample was now immersed in tube containing 3.5 ml of bidistilled water. Prior to experiment the media sur-

Table-1

Distribution of samples

Groups	Subgroups	No. of samples	Bleaching agents
Experimental	A	15	30% Hydrogen peroxide
	B	15	Sodium perborate + 30% H_2O_2
	C	15	Sodium perborate + bidistilled water
Control	D	6	Bidistilled water

Table-2

Mean leakage values of hydrogen peroxide (%) within experimental and control groups

Parameters	Experimental groups			Control group
	A	B	C	D
Means (%)	2.1427	1.094	0.3407	0.0
S.D.	3.2443	1.7602	0.3382	0.0
S.E.	0.8378	0.4545	0.873	0.0

rounding the roots of samples was checked to exclude the possibility of presence of hydrogen peroxide.

The experiment was completed in three days for three bleaching agents. Samples were repeatedly used each day in order to make direct comparison of H_2O_2 leakage from bleaching agents in same teeth.

Each day the samples were placed into an incubator at 37° C for 20 minute to simulate the body temperature. After placing one bleaching agent in pulp chamber the access cavity was sealed with a small piece of modelling wax. Samples were then subjected to thermocatalytic cycle by placing them in a dry incubator at 47° C for the period of one and a half hours.

After completion of thermocatalytic cycle 0.5 ml solution surrounding the root of each sample was taken and 2.5 ml bidistilled water was added to this. This solution was added to ferrous ammonium sulphate. In presence of H_2O_2, ferrous form changes to ferric form and upon addition of potassium thiocyanate a pink colored ferrithiocyanate complex is formed which absorbed light of 480 nm wavelength [11].

The color density developed was according to H_2O_2 present in the sample solution and this .was read in spectrophotometer in terms of optical density, which was then converted to percentage concentration of hydrogen peroxide with the help of standard hydrogen peroxide curve. Standard hydrogen peroxide curve was plotted with known amounts of hydrogen peroxide. Reading of pure 20 µl of 30 % H_2O_2 in 3.5 ml of bidistilled water served as positive control while that of reagents reading served as negative control.

The bleaching agents used on first, second and third day were 30% H_2O_2, sodium perborate mixed with 30% H_2O_2 and sodium perborate mixed with water respectively. Twenty microlitres of 30 % H_2O_2 was pipetted into the pulp chamber of each sample. Sodium perborate mixed either with 30 % H_2O_2 or bidistilled water was made into paste form in the ratio of 2 gm / 1 ml as recommended by Rotstein and Freidman[12]. Whole procedure was performed in a manner described above.

The results were analysed by students 't' test and inter comparison among three subgroups A, B & C was done by ANOVA test.

RESULTS

Almost all teeth showed H_2O_2 leakage. The means of H_2O_2 leakage of each group are summarized in table 2. No H_2O_2 leakage was found in control teeth. The comparison of the H_2O_2 leakage in percentage concentration in groups is represented by bar diagram. (Figure- 1)

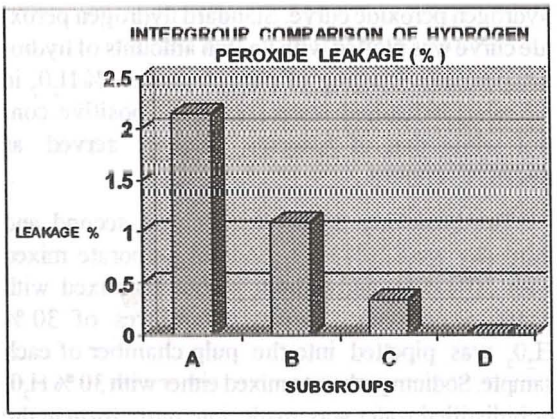
The mean hydrogen peroxide leakage was maximum in group A i.e. in which 30 % H_2O_2 was used as

Table – 3

Intercomparison of mean H_2O_2 leakage within subgroups A, B & C

Comparison	Degree of freedom	"t"	"p"
A Vs B	28	1.0989	NS*
A Vs C	28	2.1382	P<0.05
B Vs A	28	1.6292	NS

* *NS - Not significant*



a bleaching agent. Minimum leakage was found in C group i.e. in which sodium perborate mixed with bidistilled water as used as bleaching agent. In this group leakage observed was as minimum as 0.0%. In summary the maximum H_2O_2 leakage was observed in group A followed by group B and group C.

Inter comparison of mean H2O2 in subgroups A, B & C is summarized in table- 3. Since "t" value for subgroups A Vs B is not significant leakage did not differ significantly between A and B subgroups.. Since "t' value B Vs C is not significant, leakage did not differ significantly between B and C subgroups. Since "t" value for A Vs C is significant, leakage differed significantly between A and C subgroups and it was higher in A subgroup.

DISCUSSION

Discolouration of root filled teeth or teeth with necrotic pulp may be due to microleakage or the presence of different metallic compounds primarily iron sulfide. Definite oxidizing bleaching method, without post- operative complication has to be employed to correct this.

Bleaching of discoloured root filled teeth is commonly done by oxidizing method. The most common bleaching agents are 30% H_2O_2, sodium perborate or combination of these [1,2,3] . But external cervical resorption has been observed with these bleaching agents[4,5]. Various authors in their studies have recommended the use of sodium perborate mixed with bidistilled water, as this bleaching agent is not associated with the external cervical root resorption[13]. Also, there was no significant difference in clinical success of bleaching when done with sodium perborate mixed with H_2O_2 or with water[14,15]. Based on these studies a hypothesis was made in this study that there should be less H_2O_2 leakage from sodium perborate mixed with water than sodium perborate mixed with 30 % H_2O_2 or 30 % H_2O_2 alone. Hydrogen peroxide leakage was highest in group A i.e. from 30 % H_2O_2. Since, 30 % H_2O_2 is the most concentrated form of it and thus, is a stronger bleaching agent than other bleaching agents used in this study. Being in liquid form, it has more wetting property, and so, is able to seep into the space between dentinal wall and root canal filling. The leakage of H_2O_2 observed in present study was more than was observed in the study of Rotstein et al[10] . This may be because the access cavities were closed with small pieces of modelling wax during thermocatalytic cycle. This was done in order to retain the vapor of H_2O_2 so that, it could be forced into the tubuli of dentin. Thus, the combined causes i.e. liquid form, stronger bleaching agent and vapor forced into dentinal tubules led to very high penetration of 30 % H_2O_2.

The second highest leakage was observed in group B i.e. in which sodium perborate was mixed with 30 % H_2O_2. This may be because that 30 % H_2O_2 when mixed with sodium perborate becomes diluted, and the combined H_2O_2 liberating property of these two compounds becomes lesser than 30 % H_2O_2 alone. Also in paste form this bleaching agent looses its wetting property because the paste form has low coefficient of viscosity and high surface tension. The third reason may be that, more time is required to heat the paste, which boosts the H_2O_2 liberating reaction. More heat is required because molecules in solid state has less kinetic energy.

No significant leakage of H_2O_2 was observed in group C i.e. in which sodium perborate mixed with bidistilled water was used as bleaching agent. This may be because there was much less H_2O_2

available for radicular penetration as sodium perborate was the only H_2O_2 liberating compound present in this bleaching agent.

Leakage was significantly different between the subgroups A and C ($p < 0.05$), proving that much less leakage of hydrogen peroxide occurred from root when sodium perborate mixed with water was used as a bleaching agent. It can be postulated that most of the hydrogen peroxide was utilized in bleaching process and less is left to be penetrated through root surface. Different body enzymes (SOD, catalase, peroxidase) may remove the this much amount of hydrogen peroxide effectively. This may be the reason for this bleaching agent not being associated with external root resorption post- operatively as observed by Holmstrup et. al.[13]

It was observed that more leakage occurred when the bleaching agent was in liquid form than in paste form. It was also concluded that very less H_2O_2 leakage occurred from sodium perborate mixed with bidistilled water because slow reaction between these compound led to slow and controlled release of H_2O_2 and also because sodium perborate was the only H_2O_2 liberating compound in this bleaching paste.

CONCLUSION

The present study was performed to observe the amount of hydrogen peroxide leakage from intracoronal bleaching agent in order to find out minimum hydrogen peroxide leaching agent which could be used clinically without external root resorption.

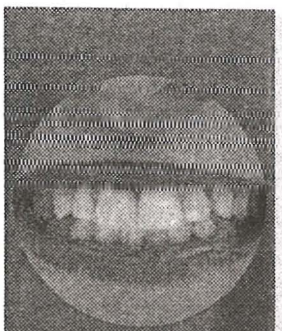
The following conclusions were deduced from this study-

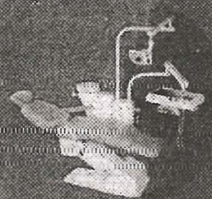
- Sodium perborate mixed with water was the best bleaching agent.
- Sodium perborate mixed with thirty percent hydrogen peroxide was the second best bleaching agent.
- Maximum radicular penetration of hydrogen peroxide was observed with 30% hydrogen peroxide. Hence it was considered the worst bleaching agent.

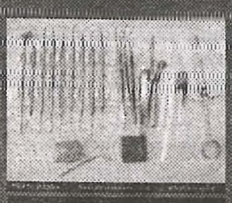
Hence sodium perborate mixed with water is suggested to be used as intra- coronal bleaching agent.

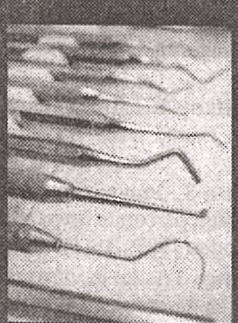
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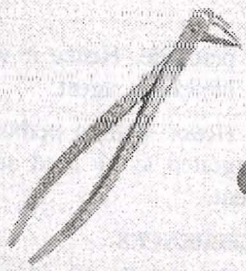
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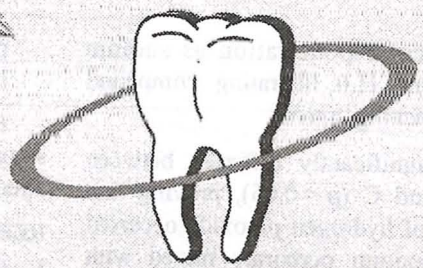


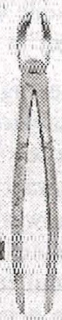












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