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COMPARATIVE EFFICACY OF HYDROGEN PEROXIDE AND NONHYDROGEN PEROXIDE BLEACHING AGENTS ON LASER ASSISTED TOOTH WHITENING -A PILOT STUDY

*DR. DEEPTHIKA B
POST GRADUATE, DEPARTMENT OF PERIODONTOLOGY AND ORAL IMPLANTOLOGY, SREE BALAJI DENTAL COLLEGE AND HOSPITAL.

DR. RANJITH MARI
SENIOR LECTURER, DEPARTMENT OF PERIODONTOLOGY AND ORAL IMPLANTOLOGY, SREE BALAJI DENTAL COLLEGE AND HOSPITAL.

DR. BALASUBRAMANIAM.V
POST GRADUATE, DEPARTMENT OF PERIODONTOLOGY AND ORAL IMPLANTOLOGY, SREE BALAJI DENTAL COLLEGE AND HOSPITAL.

DR. U.R.K. MADHUMITHA
POST GRADUATE, DEPARTMENT OF PERIODONTOLOGY AND ORAL IMPLANTOLOGY, SREE BALAJI DENTAL COLLEGE AND HOSPITAL.

ADITYA RAAJ D L
SAVEETHA MEDICAL COLLEGE
SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES

DR. ANITHA BALAJI
PROFESSOR AND HEAD DEPARTMENT OF PERIODONTOLOGY, SREE BALAJI DENTAL COLLEGE AND HOSPITAL

ABSTRACT

Background: Teeth whitening is the most frequently requested procedure by the public. 37% hydrogen peroxide for 20–30 min is commonly used for bleaching. Laser irradiation and non-peroxide bleach can minimize teeth hypersensitivity compared to H2O2 bleaching.

Aim and objectives: To compare the clinical efficacy of hydrogen peroxide and non hydrogen peroxide bleaching agents on LASER assisted tooth whitening.

Material And Methods: The sample included 10 patients who were divided into two groups; Group 1 - Opalescent Ultra Boost (37% hydrogen peroxide), and Group 2 - phthalimido peroxy caproic acid (PAP). Both groups received Laser irradiation. Patient related outcome parameters; Visual Analogue Scale, Verbal Rating Scale, Gingival irritation Score were assessed at different time intervals such as immediately after the procedure (T0), after 24 hours (T1), after 7 days (T2) and after three months (T3). Clinical effectiveness of the bleaching agent was assessed using a shade guide called Vita Classic.

Results: The scores of VAS scale, Verbal rating scale and the Gingival irritation were higher in group I than group II. In both the groups, all the three scores were higher in the immediate post-op period (T0) and gradually reduced in 24 hrs and reached zero at T2 and T3. Group II showed statistically significant SPC in than group I.

Conclusion: In conclusion, the non-peroxide bleaching agents can be a better alternative for traditional hydrogen peroxide bleaching agents.

Keywords: Teeth whitening, Hydrogen peroxide, H2O2, LASER assisted tooth whitening, non-peroxide teeth whitening

INTRODUCTION

Smile is the best ornament and is the simplest form of human communication. A beautiful smile is a harmony of shape, and color of the tooth. There has always been a craze for whiter teeth since ancient days. The willingness of individuals to have whiter teeth has caused the rise of various teeth whitening procedures in the last four decades.[1]

In the dentist's point of view, tooth whitening are frequently requested procedure by the public.[2] Teeth whitening can be achieved by utilization of commercially available toothpastes containing whitening agents like alumina (abrasives), sodium citrate (Anti Redeposition agents), blue covarine (Colorants), and sodium lauryl sulfate (Surfactants).[3] However, bleaching is the procedure of choice for tooth whitening.[4]

Bleaching can be performed in the dental clinic set up called in-office bleaching or can be done by the patients themselves at home.[3] The in-office bleaching is done with 37% H2O2, for 20–30 min. It is also called power bleaching as a high concentration of H2O2 is used. In home bleaching, a customized or specialized mouth guard which is used to apply 6-10% peroxide-containing gel.[3-5]

Few studies have reported the increase in the efficiency of peroxide with increase in temperature. Light-emitting diodes (LEDs) and LASERS are frequently used methodologies to activate the bleaching agents and amplify their effects. [6-10]

Diode lasers are usually applied for laser assisted teeth whitening procedures. Lasers produce a photochemical reaction on th bleaching agents causing release of singlet oxygen radicals with ability to remove stains.[11,12]

Various studies have compared different concentrations of the peroxide based bleaching techniques.[13-17] Though bleaching of teeth is a safer procedure, tooth sensitivity and gingival irritation after the procedure are potential drawbacks. Cysteine protease enzymes such as papain and bromelain are the newer non-peroxide agents with bleaching potential.[18] It has been demonstrated that laser irradiation and Cysteine protease enzymes can minimize teeth hypersensitivity following bleaching.[10,18.]

The present study aims to compare the clinical effectiveness in terms of smile perception changes and teeth sensitivity in between hydrogen peroxide and non hydrogen peroxide bleaching agents on LASER assisted tooth whitening.

MATERIALS AND METHODS

Study design, setting, and duration:

The present randomized controlled study was conducted on Patients who visited the Department of Periodontology and Implantology, Sree Balaji Dental College and Hospital, Chennai during September 2023 to April 2024. Using simple random sampling, participants were allocated into two groups. Institutional Ethics Committee approval was obtained before the study commenced **(ethical committee number).**

Study population:

The study included a total of 10 patients who were willing to undergo teeth bleaching procedures. These patients were categorized into 2 groups based on the type of bleaching agent they received. The groups were as follows: Group 1 - Opalescent Ultra Boost (40% hydrogen peroxide), and Group 2 - phthalimido peroxy caproic acid (PAP).

Selection Criteria:

Systemically healthy patients aged 18-25 years with no history of hypersensitivity or dentin exposure and who consented by signing an informed consent form (ICF) prior to the study, were included.

Pregnant or lactating women, individuals with Bruxism, internal discoloration like fluorosis, Dental caries, Restorations, Severe discoloration, Enamel hypoplasia, Visible cracks, Pulpitis, and Endodontic treatment in Anterior Teeth were excluded in the study.

Study procedure:

Group I patients were treated with Opalescent Ultra Boost 37% hydrogen peroxide and group II were treated with Novel bleaching agent (phthalimido peroxy caproic acid PAP). Following which, each patient in both the groups was subjected to 675 nm 3 watt, non Contact, continuous pulse mode Laser for 20s seconds per tooth. The same Procedure is repeated again after 20 minutes on each subject. (Fig 1 and fig 2) Patient related outcome parameters for tooth sensitivity; Visual Analogue Scale, Verbal Rating Scale, Gingival irritation Score were assessed at different time intervals such as immediately after the procedure (T0), after 24 hours (T1), after 7 days (T2) and after three months (T3). Clinical effectiveness of the bleaching agent as per patient's opinion of mean smile perception changes was assessed using a VAS scoring line (0 to 10 cm) at pre-op and on 7th day (T2) with the question " How do you classify your smile? 0 – not attractive to 10 – completely attractive".

Statistical analysis:
The collected data was compiled into a Microsoft Office Excel worksheet and then subjected to statistical analysis using SPSS software.

RESULTS

The visual analogue scale scores are higher in group I than group II, at T0, T1 and T2 intervals, but were not statistically significant (Table 1). The verbal rating scale scores and the Gingival irritation scores were higher in group I than group II, at T0, and T1, but were not statistically significant (Table 2 and table 3).
In both the groups, all the three scores were higher in the immediate post-op period (T0) and gradually reduced in 24 hrs and reached zero at T2 and T3. A statistically significant difference was found in group I in all the three parameters. (Table 1, 2 and 3) Inter-group Comparison shows a statistically significant difference in all the three parameters between two groups at the T0 time interval. (Table 4) Group I showed statistically significant smile perception changes (VAS - 0 to 10 cm) in than group II (Table 5)

DISCUSSION

The safer tooth bleaching procedure also has side effects like tooth sensitivity and irritation of soft tissue which still remains a major concern. [19] It has been stated that H2O2 penetrates enamel and dentine causing pulpal sensitivity.[20] As the H2O2 diffuses into the enamel, it splits into unstable free radicals which attack organic pigment molecules in the inorganic salts in tooth enamel. These reactions cause bleaching of the tooth.[21]
In order to overcome the side effects, peroxide free bleaching agents were used. Similar to peroxide bleaching agents, peroxide free agents also break down the organic double bonds.[22]
Carvalho et al[23] reported that hydrogen peroxide had superior bleaching effect and higher mucosal sensitivity than carbamide peroxide. Both bleaching agents had caused good patient satisfaction. In the present study, peroxide free bleaching agents are superior to the peroxide based bleaching agents.
In the present study, a novel bleaching agent phthalimido peroxy caproic acid was used. Bizhang et al[24] performed an in vivo study comparing the peroxide and non peroxide bleaching agents. Similar to the present study, the non peroxide bleaching agents had significant whitening effects compared to the hydrogen peroxide. However, our study has evaluated patient related outcomes rather than operator based tooth shade guide evaluation. Also, the present study has evaluated the whitening effects on the seventh day, while in Bizhang et al's it was evaluated after 24 hours.
Ferrarazi et al[25] pointed out that laser based photo-activation of hydrogen peroxide enhanced the action of the bleaching agent. The laser light increases the temperature which leads to chemical activation of bleaching agents thus enhancing the effects of hydrogen peroxide.
Hahn et al reported that chemically activated bleaching did not cause variations of the temperature within the pulp chamber, but the application of activation by light presented no advantages than the commonly used chemical bleaching. The authors added that the activation with the halogen light had the highest whitening. This could be the reason for better results in both the groups in the present study. [26]
The noteworthy findings of the present study is that non-peroxide bleaching agents are superior in terms of clinical effectiveness and lesser mucosal irritation compared to hydrogen peroxide bleaching. To the best of our knowledge, there were no other published articles that compare the clinical effectiveness and patient related outcomes of H2O2 and non hydrogen peroxide bleaching agents on laser assisted tooth whitening at a three months follow up.

CONCLUSION

In conclusion, we suggests that non-peroxide bleaching agents had higher scores of VAS, Verbal rating scale and the Gingival irritation compared to hydrogen peroxide bleaching. Also, a significant smile perception change (VAS - 0 to 10 cm) was noted in non-peroxide bleaching. The activation effect of Laser, which is commonly used in dental practice nowadays, has shown to be superior. Studies with larger samples, different bleaching agents, and longer follow up should be considered for better reliable results.

Table 1; Comparison of visual analogue scale scores in two groups at different time

Groups	Time	Mean	SD	P value
Group I (Hydrogen peroxide bleaching)	Immediate (T1)	3.60	0.58	0.05*
	24 hrs (T2)	1.00	0.71	
	7 days (T3)	0.4	0.55	
	3 months (T4)	0.0	0.00	
Group II (non-peroxide bleaching)	Immediate (T1)	0.80	0.84	0.319
	24 hrs (T2)	0.40	0.55	
	7 days (T3)	0.0	0.00	
	3 months (T4)	0.0	0.00	

Table 2; Comparison of Verbal rating scale scores in two groups at different time

Groups	Time	Mean	SD	P value
Group I (Hydrogen peroxide bleaching)	Immediate (T1)	2.00	0.00	0.001*
	24 hrs (T2)	0.6	0.55	
	7 days (T3)	0.0	0.00	
	3 months (T4)	0.0	0.00	
Group II (non-peroxide bleaching)	Immediate (T1)	0.60	0.55	0.253
	24 hrs (T2)	0.20	0.48	
	7 days (T3)	0.0	0.00	
	3 months (T4)	0.0	0.00	

Table 3; Comparison of Gingival irritation scores in two groups at different time

Groups	Time	Mean	SD	P value
Group I (Hydrogen peroxide bleaching)	Immediate (T1)	1.800	0.45	0.001*
	24 hrs (T2)	0.80	0.46	
	7 days (T3)	0.0	0.00	
	3 months (T4)	0.0	0.00	
Group II (non-peroxide bleaching)	Immediate (T1)	0.80	0.45	0.289
	24 hrs (T2)	0.60	0.55	
	7 days (T3)	0.00	0.00	
	3 months (T4)	0.00	0.00	

Table 4; Intergroup Comparison of all the three parameters in two groups at different time intervals

Variable	Timeline	Group	Mean	Std. Deviation	P value
Visual Analogue Scale	Immediate	I	3.6000	.54772	0.0001*
		II	.8000	.83666	
	24 hours	I	1.0000	.70711	0.172
		II	.4000	.54772	
	7 days	I	.4000	.54772	0.141
		II	.0000	.00000	
	3 months	I	.0000	.00000[a]	*
		II	.0000	.00000[a]	
Verbal rating scale	Immediate	I	2.0000	.00000	0.0001*
		II	.6000	.54772	
	24 hours	I	.6000	.54772	0.242
		II	.2000	.44721	
	7 days	I	.0000	.00000[a]	*
		II	.0000	.00000[a]	
	3 months	I	.0000	.00000[a]	*
		II	.0000	.00000[a]	
Gingival irritation scale	Immediate	I	1.8000	.44721	0.008*
		II	.8000	.44721	
	24 hours	I	.8000	.44721	0.545
		II	.6000	.54772	
	7 days	I	.0000	.00000[a]	*
		II	.0000	.00000[a]	
	3 months	I	.0000	.00000[a]	*
		II	.0000	.00000[a]	

Table 5; Comparison of smile perception changes (VAS - 0 to 10 cm) in two groups at seventh day

Groups	Mean	SD	P value
Group I (Hydrogen peroxide bleaching)	3.50	0.45	0.001*
Group II (non-peroxide bleaching)	6.50	0.85	0.001*

Figure 1; Teeth bleaching in group I (a) pre-op shade matching done using VITA CLASSIC shade guide, (b) b)Application of hydrogen peroxide bleaching agent, (c) Irradiation with Laser light of 675 nm, 3 watt non contact mode laser for 20 secs on each tooth surface, (d) Postoperative shade matching done using VITA CLASSIC shade guide

Figure 2; Teeth bleaching in group II (a) pre-op shade matching done using VITA CLASSIC shade guide, (b) b)Application of PAP bleaching agent, (c) Irradiation with Laser light of 675 nm, 3 watt non contact mode laser for 20 secs on each tooth surface, (d) Postoperative shade matching done using VITA CLASSIC shade guide

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