

## One-year Clinical Evaluation of a New Bleaching Product Used with and without Light

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### Abstract:

**Background:** This *in-vivo* study compares the outcome of vital teeth bleaching, with and without light.

**Materials and Methods:** A total of 40 subjects were selected based on an exclusion and inclusion criteria with a minimum shade of A2 (classical Vitapan shade guide and electronic easy shade). The subjects were split into two groups. Group 1: One session of in-office bleaching using 30% hydrogen peroxide, without light. Group 2: In-office bleaching using 30% hydrogen peroxide with light. Both groups were given prefabricated home bleaching disposable trays containing 8% hydrogen peroxide to be used for 3 days. A color stability was evaluated during a period of 1-year, at baseline initially before bleaching (T0), at 1 month (T1), 3 months (T3), 6 months (T6), and 12 months (T12). Subjects were given a sensitivity log sheet to report any sensitivity during treatment. Different statistical tests, Wilcoxon and Mann–Whitney were used to analyze the results.

**Results:** Teeth bleached appeared lighter when compared to baseline with and without light while when comparing the use of light to no light, no significant difference was registered.

**Conclusion:** The use of light is not mandatory for the success of in-office bleaching.

**Key Words:** Carbamide peroxide, clinical study, hydrogen peroxide, in-office bleaching

### Introduction

Population's growth in dental awareness through internet, networks and lifestyle, have increased their demand for a natural smile. Patients nowadays come for a "whiter and brighter" smile, which is the trend in the latest dental fashion. The rise of this demand in parallel with the philosophy of conservative and minimal invasive dentistry, have led dental clinicians to practice more and more bleaching, which whitens teeth without any loss of tooth structure. Bleaching has been

used in dentistry for over a decade, and since 1911 hydrogen peroxide was the first used to lighten discolored teeth.<sup>1</sup> Numerous methods have been described in the literature for the bleaching of vital teeth. Mainly, three techniques are mostly used; in-office or power bleach, night guard bleach or home bleach, and mass market or over the counter bleaching products. The use of light or in-office power bleaching introduced in 1918 is the oldest form of tooth whitening and is up to date, advised and used by some dentists. Heat generated from light combined with strong chemicals was thought to boost the tooth whitening at chair side.<sup>2</sup> It works by activating the peroxide and allowing it to diffuse more quickly, to accelerate the chemical redox reactions. It is also mentioned that the light source could energize the tooth stain and aid in overall acceleration of the bleaching process,<sup>3,4</sup> but whether it showed better long-term results than the treatment achieved without light, is still equivocal. In fact, some studies showed positive results of light activated bleaching agents<sup>2,5</sup> while other studies conducted *in vivo*, most found no added benefit for light-activated systems.<sup>6-9</sup> This could be explained by the difference in methods used to analyze the bleaching efficiency. In home bleaching, mainly two molecules are used; hydrogen peroxide or carbamide peroxide; the latter being most common as a home bleaching material.<sup>10</sup> Although the mechanism of bleaching is not yet fully understood, it is known that there is a diffusion of peroxide to and through enamel that reach the enamel, dentine junction and the dentine region leading to an oxidation reaction. On a chemistry level, the hydrogen peroxide proceeds via the perhydroxyl anion or as free radicals of H, OOH and 2OH.<sup>1</sup> Carbamide peroxide is a precursor that decomposes to release hydrogen peroxide in an aqueous medium. 10% carbamide peroxide yields roughly 3.5% hydrogen peroxide.<sup>1</sup> In-office bleaching materials contain high hydrogen peroxide concentrations, typically 15-38% while the hydrogen peroxide content in at-home bleaching products usually ranges from 3% to 10%. However, there are some home-use products containing up to 15% hydrogen peroxide that has raised a concern as more than 10% has proven to be cytotoxic and harmful to mucous membrane.<sup>11</sup> In comparison between the three techniques, in-office bleaching has shown many advantages such as clinician control, quick initial results and reduced treatment time in addition to avoiding any accidental material ingestion and discomfort in wearing trays, making it a pioneer in bleaching treatments. Today, clinicians concerns can be summarized as the choice of the best bleaching material and its concentration, the use of a bleaching light and its effectiveness, the duration of a bleaching treatment as well as the longevity of the results. The null hypothesis tested in

the present study is whether the use of light yielded the same or better long-term bleaching results using a new bleaching product with its light.

### Materials and Methods

About 40 healthy patients both males and females, aged between 18 and 25 years old were involved in this clinical study. A patient selection was made according to a strict inclusion and exclusion criteria. The inclusion criteria were; a minimum shade of A2 with at least six maxillary and mandibular anterior teeth, restorations and caries free. While exclusion criteria were the absence of any medical diseases or oral pathology that may interfere with the study, tobacco consumer, a patient with a previous bleaching treatment, pregnant or lactating female and stains caused by tetracycline. Initial tooth shade was evaluated and registered using visual VITAPAN classical Shade guide (VITA Zahnfabrik, Germany) and an electronic shade guide VITA Easy shade Compact (VITA, North America). After ethical committee approval of the protocol, informed consent was signed by each patient.

Three trained dental clinicians performed the bleaching treatment during 1 month, according to a double-blinded procedure. Patients were divided randomly into two groups; Group 1: 30 % hydrogen peroxide without light, Group 2: 30% Hydrogen peroxide MeToo™ (Acteon, Pierre Rolland) with the light device using infrared (IR) and blue LED components. The light runs under three programs; full: 100% blue + 100% IR, medium: 50% blue + 50% IR and cold: 100% blue, no IR. Full power intensity was applied for Group 2 patients at first application. If sensitivity occurred during treatment, the program is shifted to medium and if persisting, decreased to cold. The procedure was applied as specified by the manufacturer and is shown in Table 1. The following in-office bleaching session, a desensitizing agent; MeToo™ Calm was applied on patient's bleached teeth and three prefabricated

home trays containing 8% hydrogen peroxide gel were given, to be used in the three consecutive days following the in-office bleaching session. Patients were given a sensitivity log sheet to register any sensitivity occurrence during treatment.

All patients involved in the study were given appointments at almost same hours of the day to avoid environmental delusions of vision, during evaluating the color using the classical visual Vitapan which is subjective. The shade was evaluated by two separate evaluators at baseline (1 month), 3, 6 and 12 months. Using visual and electronic shade guides for evaluation. Each examiner evaluated the upper anterior teeth 13-23 taking the shade from the center of the tooth to produce a fair comparison and a reproducible position. In the case of disagreements, evaluations were repeated until a consensus was reached. Table 2 shows the products and materials used in this clinical trial.

### Statistical evaluation

Statistical analysis was conducted using two non-parametric tests: Wilcoxon with a  $P < 0.05$  and Mann-Whitney test with a  $P < 0.05$  since the values did not follow a symmetrical distribution.

### Results

The results including mean and standard deviation are shown in Table 3 and Graph 1a-d. The results obtained for Groups 1 and 2 did not show any significant difference whether light source was used or not. The mean shade score for both incisive and canines decreased significantly ( $P < 0.0001$ ) within time; represented clinically as a lighter shade, especially between baseline (T0) and 1 month (T1) were no significant difference was found between 1, 3, 6 and 12 months, but none regressed to the initial darker tooth shade. When comparing visual and electronic shades, no significant difference was found between centrals and laterals ( $P < 0.05$ ) while a significant difference was found between canines and incisive. Canine showed a better degree of shade improvement between baseline and 1 month. Regarding sensitivity, six patients complained only during bleaching treatment while three others reported sensitivity during the home bleaching procedure.

### Discussion

The results of this study confirm the clinical effectiveness of 30% hydrogen peroxide MeToo™ bleaching material. Immediate shade measurements could not be done due to the dehydration of the bleached teeth, caused by high concentrations of hydrogen peroxide and heat from light source.<sup>11,12</sup> Actual color change is evident only 2-6 weeks post bleaching treatment.<sup>11</sup> Color evaluation at 1 month; T1, showed a significant difference in comparison to the initial shade before bleaching at T0 for both incisors and canines; Graph 1a-d. A statistical analysis was performed separately for centrals, laterals and canines to see if any difference between individual teeth types exist. A decrease in mean shade score

Table 1: Application of product.

Product	Application technique
NeoDam	Apply NeoDam to the gingiva. Slightly overlap enamel. Cover interproximal spaces to achieve the best protection Cure the dam until complete color change
Acteon MeToo 30% hydrogen peroxide syringe	Apply the content of one MeToo Light syringe to both arches
Acteon Lamp	Position MeToo Deluxe and switch on for a 15 min session Undertake 3 sessions in total Double activation: Photonic: Blue light 450-480 nm Thermic: IR light 835-865 nm No UV light that can damage soft tissues Optical power (radiometric): 5W (blue light), 1.5W (IR)
Acteon MeToo 8% hydrogen peroxide syringe	After chair side whitening to stabilize the results 3 disposable trays pre-filled with 8% hydrogen peroxide gel are used

IR: Infrared, UV: Ultraviolet

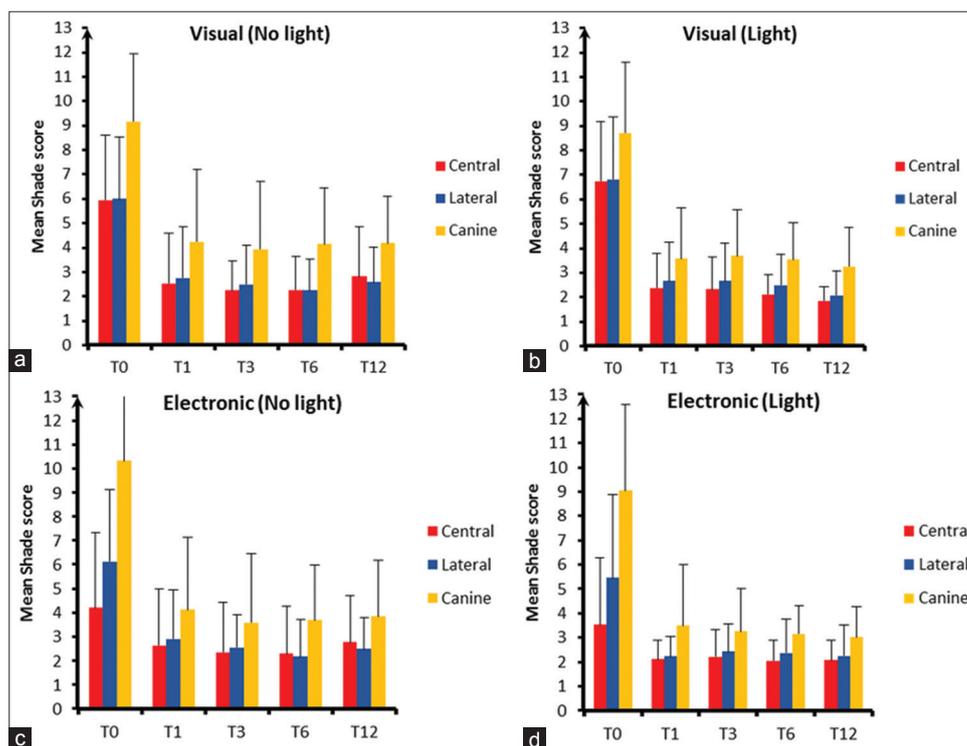
**Table 2: List of materials.**

Product name	Product content	Manufacturer	Batch number (LOT)
Acteon MeToo	30% hydrogen peroxide gel	Pierre Rolland Acteon	4715
Acteon MeToo	8% hydrogen peroxide filled trays		4715
Neodam	Light curing Dam		4478
MeToo calm	Desensitizing agent		4711
MeToo isolation	Disposable retractor integrated with a bilateral suction system unit.		5018
Curing light			

**Table 3: Comparison between visual and electronic shade guides.**

Groups	Time	Shade assessment		Mean difference	Significant	95% confidence interval for difference	
						Lower bound	Upper bound
No light	Baseline	V	E	-0.118	0.864	-1.498	1.263
	1 month	V	E	-0.147	0.659	-0.818	0.524
	3 months	V	E	-0.059	0.843	-0.657	0.540
	6 months	V	E	0.059	0.796	-0.399	0.517
	1 year	V	E	0.088	0.790	-0.581	0.758
Light	Baseline	V	E	1.342	0.044	0.036	2.648
	1 month	V	E	0.421	0.187	-0.214	1.056
	3 months	V	E	0.237	0.401	-0.329	0.803
	6 months	V	E	0.132	0.541	-0.302	0.565
	1 year	V	E	-0.184	0.558	-0.817	0.449

The only significant difference between visual and electronic was with light at T0 ( $P < 0.05$ )



**Graph 1:** (a-d) Comparison between light and no light for incisive and canines using visual and electronic shade guides.

of centrals was confirmed clinically by shade enhancement. The initial shade T0 ranged between A2 and D2 where at T1 the mean shade score decreased for both Groups 1 and 2 (no light and light). For Group 1 (no light) the shade was enhanced in a range of D2-B2 while for Group 2 (with light) resulted in a lighter shade range from A2 to B2, yet not statistically significant. Shade showed stability from T1 through T12. The central incisor with light source showed

better results although insignificant, ( $P > 0.05$ ). In Table 3 comparing visual and electronic shade, a significant difference was found at T0. The lateral incisors confirmed similar results as to the central incisor as shown in Graph 1a-d. Concerning the canines, the initial shade T0 was significantly higher in comparison to centrals and laterals, yet decreased at T1 and stabilized through T1-T12. When comparing the incisive and canine, as shown in Graph 1a-d. No difference was found

between centrals and laterals as mentioned previously while a significant difference ( $P < 0.05$ ) was found between incisive and canines. This could be explained by the fact that the canine is initially darker compared to incisive, due to its morphology, resulting with an initial high mean score. No significant difference was found between the electronic shade guide and visual, but electronic readings were a more consistent since it was not affected or sensitive to the surrounding environment, providing more precision.<sup>13,14</sup> At T1 teeth bleached with light showed an enhancement in shade in comparison to one without, then the rest of results proved that there was no significant difference between using light or without. Results of the present investigation were in accordance with other studies that concluded that the use of light source did not enhance the bleaching effect.<sup>6,15</sup> Papathanasiou *et al.* found no significant effect of light activation in a study of 20 patients using a 35% hydrogen peroxide opalescence gel (opalescence Xtra).<sup>6,9</sup> In another study by Marson *et al.*, the authors found that when using three applications over 15 min of 35% hydrogen peroxide and three different lamps, no significant differences was found when applying gel with or without light.<sup>6,16,17</sup> Other studies showed contradictory results. This could be explained by the differences in the methodology used as well as the technique of shade measurement. In other studies, when lower concentrations of hydrogen peroxide were used in-office, the use of light proved better bleaching efficacy.<sup>18</sup> Concerning the sensitivity, despite that all patients received a topical application of MeToo™ calm, some patients had post-operative sensitivity that ceased within 24-48 h. In this study, the initial sample size was  $N = 20$  for each group. But after 1 year recall, the sample size was reduced to  $N = 19$  with light and  $N = 17$  with no light. One disadvantage of longitudinal studies is the loss of patients that do not attend recalls for several reasons such as some flew out of country and others did not commit to recalls. A further investigation could be to use a split-mouth design in order to discard the responsiveness factor of each patient so that the factor in which individuals teeth respond differently to bleaching material is eliminated, as the control would be half the arch of the same patient. An in-office bleaching session after the consecutive 3 days of 8% home bleaching could be done, which could have improved the results. In the end, patient satisfaction is a key to success where it occurred more often when more than one in-office bleaching session was done.<sup>19,20</sup>

### Conclusion

Within the limitation of the present study, it can be concluded that the use of light is not mandatory for the success of in-office bleaching. The use of high concentrations of hydrogen peroxide is effective solely as an in-office material. Additional application of bleaching material for canines will allow them to reach similar shade as incisives due to their physiological darker shades.

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