



LOMA LINDA UNIVERSITY
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Tooth Bleaching with Light Activation: Intensity Matters

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INTRODUCTION

Tooth bleaching with light activation has revolutionized the model for external bleach therapy and has especially attracted the consumers. Activating light sources such as quartz-tungsten-halogen (QTH) lamps, plasma arc lamps, laser systems with a variety of wavelengths, and light emitting diodes (LED) have been used to enhance the chemical decomposition of hydrogen peroxide, thus enhancing whitening efficacy. However, **the mechanism by which light therapy works** is still not fully understood and remains a controversy. Theories of heat, chromogen excitation, and photocatalytic activation have been proposed, yet there is no scientific study to support conclusive evidence. Additionally, there is no consensus on **which light source is best** in promoting bleaching efficacy.

The objective was to determine how effective different light sources perform when the bleaching agent used was the same. We **hypothesized** that there will be a significant difference in teeth treated with and without light therapy and teeth that have been treated with light will exhibit lighter shades. Also, there will be differences in color change among the three different light sources used. We hypothesize that **the higher the intensity of light, the better the bleaching results**.

MATERIALS AND METHODS

Sample Selection and Preparation:

Sound human third molars (N=100) were collected, roots trimmed 2 mm apical to the cemento-enamel junction and the pulp removed. Specimens were mounted on a dish with super glue. The specimens were placed in artificial saliva for 24 hours at room temperature.

Experimental Groups:

- NC: Water of grade 3 for 10 min for 10 days.
- OW-NL: 9% hydrogen peroxide (HP), 10 min, 10 days without light.
- OW-OWL: 9% HP, 10 min, 10 days with Optic White light.
- OW-AGL: 9% HP, 10 min, 10 days with Aura Glow light.
- OW-ZOOM: 9% HP, 10 min, 10 days with Zoom light.

Tooth Color Change Assessment:

Instrumental color measurements were performed on the middle third of the buccal surface using an intraoral spectrophotometer (VITA Easy shade Compact). A custom fabricated jig was used for repeated measurements. Results were expressed by recording L*, a*, and b* values at baseline (T1), 1-day post-treatment (T2), 1-week post-treatment (T3). The overall color change expressed as ΔE_{ab}^* was calculated as follows,

$$\Delta E_{ab}^* = [(L^*-2)^2 + (a^*-2)^2 + (b^*-2)^2]^{1/2}$$

MATERIALS AND METHODS

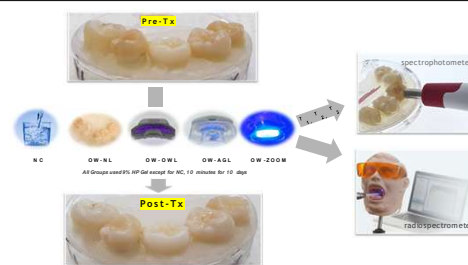


Figure 1. Flowchart of Experimental Protocol

Statistical Analysis: Kruskal Wallis procedure was used to determine differences in color change among groups. Tests of hypotheses were two-sided with an alpha level of 0.05.

RESULTS

Light Source Characterization:

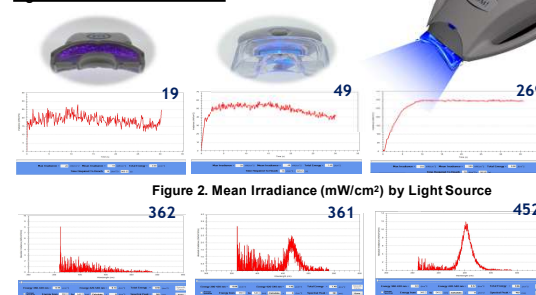


Figure 2. Mean Irradiance (mW/cm²) by Light Source

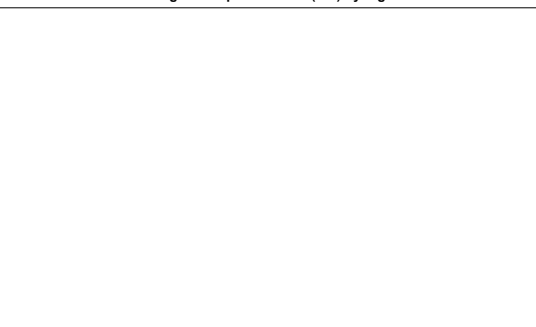


Figure 3. Spectral Peak (nm) by Light Source

RESULTS

Tooth Color Change:

There was no significant difference in all color parameters at baseline ($P > 0.05$). There was a statistically significant difference in overall color change at T2 and T3. After multiple comparisons Group OW-ZOOM showed the highest color change at T2 and T3 ($P < 0.05$).

Table 1. Overall Color Change at 1 day and 1-week Post-Tx by Group

	NC	OW-NL	OW-OWL	OW-AGL	OW-ZOOM	P-value
$\Delta E^*_{1\text{ day}}$	2.1 ± 1.1 ^a	5.6 ± 3.2 ^b	5.4 ± 2.3 ^b	5.7 ± 2.6 ^b	10.1 ± 4.3 ^c	<0.001
$\Delta E^*_{1\text{ wk}}$	2.2 ± 0.9 ^a	5.3 ± 2.0 ^b	5.7 ± 2.6 ^b	6.2 ± 2.7 ^b	10.5 ± 4.5 ^c	<0.001

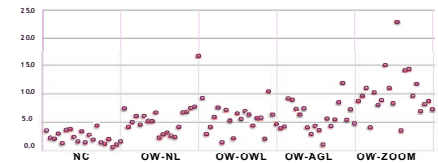


Figure 4. Scatterplot of ΔE^* by Group at 1 day Post Whitening

DISCUSSION & REFERENCES

The use of light activation in tooth whitening has been a controversial topic. Based on the results, we **accepted our hypothesis**. There was a difference in overall color change among the groups. The negative control exceeded the perceptibility threshold of 1.2 but was less than the acceptability threshold of 2.7. There was no difference between OW-NL, OW-OWL, and OW-AGL indicating that light activation with a low intensity light did not have a boosting effect. The OW-ZOOM had the greatest color change indicating that light activation with a high intensity light promotes bleaching efficacy. The study is limited by the in vitro design that does not fully replicate the full dynamics of the in vivo oral environment. Within the limitations of the study, we **conclude that light intensity matters when considering the best light source for bleaching activation**.

Future studies could evaluate influences of pH, photo activators, temperature, and other factors that affect the process of tooth whitening.

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