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Effectiveness of Blue or Violet Led During Dental Whitening Processes; A Review

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Abstract
Background: *In this review, we conducted the effectiveness of purple or blue LED during whitening procedures of vital teeth.* ***Methodology****: When clinical and in vitro studies on whitening treatment are analyzed by searching the PubMed and google scholar databases over the past two years. The studies included were: 1) whitening-related studies; 2) studies on purple LED Light (405-410nm); and 3) studies analyzing effectiveness. 4) Studies on blue Led Light. In order to find an answer to the research question, the authors systematically and biaslessly scanned the original studies published in that field, in accordance with the determined criteria, evaluated the validity of the studies and synthesized them. Results: Approximately 895 articles were found in the databases during the search process. After the preliminary selection consisting of title and abstract evaluations of the studies, 18 articles were selected. It was seen that there was no standard in in vitro studies.* ***Conclusion:*** *When the literature research was evaluated, it was understood that violet light, one of the light devices used during whitening treatments, was preferable due to its shorter wavelength and fewer post-operative negative properties.*

Key Words*: Bleaching, Blue Led, Violet Led, Whitening Processes*

I. Introduction

Nowadays, aesthetic dentistry practices have gained popularity as a result of people's increasing desire to have whiter teeth [1] . Individuals' desire to have whiter teeth and increase the aesthetic appearance has made teeth whitening treatment a popular treatment option. Teeth whitening treatment internal and external teeth [2]. It is considered a conservative, safe, effective and minimally invasive method that can be applied to color discolorations [3].

Electromagnetic radiation sources were first used by Ames in 1937 to increase the effectiveness of whitening by heating the whitening gel containing 35% HP 4. The use of infrared lamps to accelerate the activation of hydrogen peroxide-containing gel emerged in the early 1980s [5]. It was thought that this application should be improved because it creates thermal stress in the pulp tissue, and different light sources were used [5, 6].

Highly concentrated HP used in office whitening can be impeled by heat and light sources [7.] Quartz-tungsten-halogen (QTH) and plasma arc lamps, LED (light emitting diodes), lasers of different wavelengths and hybrid light sources (LED/laser) are used to accelerate the decomposition reaction of hydrogen peroxide in the whitening gel [7, 8].

There are conflicting results in the literature on the subject 9, 10, and a definitive conclusion cannot yet be reached as to whether light activation provides more permanent or more effective whitening with whitening gels [5, 10]. As a matter of fact, light device activation is a great help in achieving the expected result in a shorter time and shortening the time the patient spends in the office. It provides an advantage [11, 12.]

The light system used for light-activated whitening treatment is light sources used for resin polymerization with an extra setting for whitening (whitening mode). Light systems specially designed for whitening procedures are designed to activate the entire dental arch or multiple teeth [8]. LED systems used in light-activated whitening treatments usually consist of multiple LEDs mounted side by side [8]. LED lights emit light that disperses over a bandwidth of 20-80 nm. Therefore, LEDs fall between monochromatic lasers and wide bandgap light sources such as QTH and plasma arc lamps [8]. The emission of LEDs used in systems available for light-activated whitening is in the blue range[8].

It has been described in the literature that the violet LED wavelength causes the disintegration of stained particles and results in whitening using a physical process [13]. Purple LED (405-410 nm) light source carries more energy and is less absorbed into the tooth surface matched to Blue LED (470 nm) light source [14].

Another important feature of the 405-410 nm wavelength is that it causes the disintegration of the H2O2 molecule and the speeding up to the photolysis reaction [15]. In this way, purple LED light can interact with hydrogen peroxide and pigments inside the tooth. However, as violet light has a low ability to penetrate teeth [16], it has been found to have limited interaction with the enamel surface when applied alone [17], but when applied with a peroxide light, an increase in luminescence occurs. Chemical degradation of pigments is achieved with purple LED.

Purple LED light should be used without bleaching gels in patients reporting tooth sensitivity, and it is recommended to use it with high concentration H2O2 in patients with no or low tooth sensitivity [14, 18].

II. Material And Methods

Search strategy and definitions

All randomized controlled studies published in Google Scholar and Pubmed in the last two years, describing the blue and purple LED lights used during vital whitening and their effective mechanisms, were included in the compilation. In order to prevent the risk of bias, randomization and blinding methods were required to be described in the selected articles.

Selection Criteria

A comprehensive search was conducted in two databases: MEDLINE (PubMed) and google scholar. The basic list of keywords used included: (Whitening OR Bleaching) AND ("blue LED" OR purple LED OR "Dental bleaching LED" OR "teeth whitening dental purple LED Light" OR "teeth whitening Studies on blue Led Light" OR "whitening -related studies").

Study Selection

When literature studies are scanned, PubMed and google scholar databases over the past two years were identified. The studies included were: 1) whitening-related studies; 2) studies on purple LED Light (405-410nm); and 3) studies analyzing effectiveness. 4) Studies on blue Led Light. In order to find an answer to the research question, the authors systematically and biaslessly scanned the original studies published in that field, in accordance with the determined criteria, evaluated the validity of the studies and synthesized them.

III. DISCUSSION

This review is a study that presents data collected from experimental in vitro studies measuring the effects of blue LED and purple LED light devices used during whitening processes.

Since the 1980s, blue LED has been used in modern dentistry and teeth whitening treatments 8. For this reason, it is necessary for whitening gels to increase light absorption and contain dyes such as carotene (orange-red) in their composition to convert energy into heat in order to use the blue LED device 19. Additionally, studies have shown that purple LED exhibits superior performance when associated with peroxides 14, 19, 20, with the emission of photons corresponding to the wavelengths of the chromophores [21, 22].

Purple LED (405 ± 10 nm) and blue LED (450 ± 10 nm) light, which promote high free radical production, have shown that the use of whitening agents increases their effectiveness [23-25]. These radicals interact intensively with the tooth structure, reducing the application time and extending the whitening process [15, 26].

The wavelength range of violet light causes molecules to break down into smaller, colorless components. However, since this technique is new and introduced recently, studies on its bleaching effectiveness are insufficient and its possible side effects are not fully known [27].

A study investigating dentists' preferences for light devices in whitening. According to the survey study; While 49.3% of dentists use UV light devices, 10.8% use blue LEDs and lasers, 39.9% prefer treatment without light activation28-30. According to the results of another survey study, dentists who prefer light activation. While they constitute 58.6% of the total, 41.4% do not use light devices for vital whitening 28, 31, 32. The results of another study showed that LED light devices were used in 44.8%, lasers were used in 15.2% and halogen light sources were used in 11.7%, while light activation was not used in 28.3% [28, 33, 34].

Light sources used in whitening therapy emit high intensity violet to blue light, which is associated with various types of tissue damage, but contain virtually no UV light 35. Despite all this, not enough studies have been done on the effects of blue light on oral tissues.

Mitochondria contain flavin proteins [36-38]. It has also been determined that O2 is produced by irradiating flavin with blue light [39.] So, when tissue is irradiated with blue light or violet light, it causes photodamage to the pigment molecules inside the cells. All pigment molecules have a stimulating wavelength, and free oxygen radicals are manufactured when oxygen is present both inside and outside cells while they are alive.

Studies have shown that some cells have chromophores that absorb blue light. Short-wavelength blue light (about 400 nm) is immersed by the Soret band in porphyrins, while long-wavelength blue light is engrossed by flavins and opsins [40, 41]. Many of these chromophores trigger ROS production through diverse mechanisms. Additionally, blue light can release nitric oxide (NO) from intracellular stores (hemoglobin and nitrosothiols) in the mitochondria [42]. The formation and formation of NO can lead to intracellular energy depletion and neuronal cell death [43].

Therefore, the aim of this review is to appraise the effect of light sources used in whitening processes.

CONCLUSION

New devices, materials and light sources are often used in the treatment of teeth whitening. The studies on the damages caused by these oral tissues were partially. Blue, purple and white light, one of the various light sources, caused a number of physiological problems. So, it was understood that the most advantageous whitening method for patients was purple light, especially due to the lack of postoperative pain.

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