

## A Comparative Clinical Study of the Efficacy of Two Bleaching Protocols - One Year Follow-Up

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**Abstract: Objectives:** The purpose of the present study was to measure color changes of bleached teeth over a period of one year follow up using different methods. **Materials & methods:** Twenty highly educated adolescents (age range 18-25 years) seeking for better esthetics were enrolled into the study. Their teeth shade was A3 or darker. Participants were enrolled in a split mouth study design divided into two equal groups according to bleaching materials used. Group I: Maxillary anterior teeth were received (In-Office) bleaching material (N=20). Subgroup A: the color measurement was performed using spectrophotometer (N=10), Subgroup B: the color measurement was performed using shade tab (N=10). Group II: Mandibular anterior teeth were received (Over-The Counter) bleaching material (N=20): Subgroup A: the color measurement was performed using spectrophotometer (N=10), Subgroup B: the color measurement was performed using shade tab (N=10). The color change was recorded using different techniques along the evaluation periods at baseline, before any treatment, directly after bleaching and in 3 months intervals for a year postoperatively. **Results:** Friedman test was done to study the effect of time on the color change for each tested group. It revealed a significant difference in Group I (sub group A) as compared with other group and subgroups since P value equal 0.017. To find out which period of time is responsible for that significant difference, Mann-Whitney U test was used. This analysis showed that after 9 months, and after one year evaluation periods for group I was mainly responsible for this significant difference against other evaluation periods. However the data representing color change for group II just after treatment and after 9 months follow up periods was also significantly different compared to those at baseline, after 3,6,12 months. **Conclusion & recommendations:** The color improvement is superior in the in-office bleaching compared to the OTC bleaching technique. It is recommended that over the counter products should be used under strict manufacturer's instruction.

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**Keywords:** In-office bleaching, over the counter bleaching, spectrophotometer, vita classic shade guide.

**Abbreviations:** OTC= Over The Counter

### 1. Introduction

Today in modern societies, people are continually asking for pretty appearance, and this includes white teeth a beautiful smile [1]. Esthetic or cosmetic dentistry is an important part of restorative dental practice which aims to combine function and prettiness with the values and personality requirements of each patient [2].

Discoloration of tooth can be affected by a number of extrinsic and intrinsic factors. Stains of extrinsic origin are related to deposition of either beverages or food stains on the surface of teeth. On the contrary, intrinsic stains are associated with enamel and dentin properties [3]. There are many options offered to improve and advance teeth color like whitening toothpastes, professional mechanical or chemical stain removal, enamel micro/macro-abrasion, vital tooth bleaching, restorations with lighter composite, ceramic veneers and full coverage crowns [4].

Teeth bleaching is considered the least invasive way to improve teeth color utilizing oxygenating chemicals such as hydrogen peroxide, carbamide peroxide and sodium perborate. The breakdown of hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) leads to formation of oxygen and per-hydroxyl free radicals which oxidize the stained macromolecules and break them down into smaller, lighter colored and diffusible fragments [5]. Then, the fragments disperse across the tooth surface which results in the bleaching effect [6].

There are many techniques and methods of vital tooth bleaching which may be categorized as In-office (professionally administered), At-home (professionally dispensed) or Over-the-counter (self-administered) [7]. In-office bleaching is an accepted choice available to patients who need a more beautiful and whiter smile because the results of bleaching procedures can be seen and noticed in a single clinical visit with a dental professional [8,9]. While, At-home whitening includes the application of a whitening agent with low concentration of (10-20% carbamide

peroxide) placed in a special mouth guard prepared for the patient and used daily over a 2-6 weeks period (This should be supervised by a dental professional) [10].

Moreover, different OTC whitening products appeared in the USA in the start of the 2000s, as an option to manage discoloration of the tooth with lower fee than conventional proficient prescribed/guided whitening materials. OTC products are accessible in many places like drug stores, supermarkets or even on the shopping sites on internet, including mouthwashes, gel, dentifrices, chewing gums, paint-on brushes, dental floss, and whitening strips without any prescription or professional supervision [11-13]. However, these methods of tooth whitening and bleaching treatments may be damaging and the outcome may not have a good quality as those obtainable by dentist-guided protocols of treatments.

Different objective and subjective methods were designed to assess discoloration of tooth in addition to bleaching effects of different bleaching methods [14,15]. While spectrophotometers may present

dependable assessments, most studies were performed by comparing subjective methods using acrylic resin shade guides [16].

Many researches denoted that post-treatment sensitivity is a well-known problem following bleaching techniques frequently associated with subsurface pores and tiny microscopic defects of enamel, which leads to penetration of whitening agent into the dentinal tubules and eventually to the pulp, which may lead to reversible pulpitis and consequential teeth thermal sensitivity [17,18]. Using desensitizing agent containing a 5% potassium nitrate and 2% sodium fluoride was found to be useful to treat post-operative sensitivity following vital bleaching regimen [19,20].

Thus it was interesting to design a clinical study to evaluate the effect of different bleaching protocols on the color change using different color evaluation methods over one year clinical follow up period.

## 2. Materials and Methods

### 2.1 Materials

**Table -1: Materials used in the Study:**

Materials	Chemical Compositions	Manufacturer	Web site
WHITE smile. LIGHT WHITENING AC	32% hydrogen peroxide, Aqua, Silica, Glycerol, Organic amines, Poly-glycols, and chlorophyll.	WHITE smile GmbH Birkenau Germany	<a href="http://www.whitesmile.de">www.whitesmile.de</a>
Crest 3D White Luxe Supreme Flex Fit White strips	5.3-5.6% hydrogen peroxide, PVP, PEG-8, water, glycerin, carbomer 956, sodium hydroxide, Acrylates Co-polymer and Sodium saccharin	Crest, Procter & Gamble USA	<a href="http://www.3Dwhite.com">www.3Dwhite.com</a>

### 2.2 Study setting:

This study was performed in the Restorative department clinics, Faculty of Dentistry, Tanta University.

### 2.3 Study design:

It was conducted as a controlled segmented clinical trial for one year with 3 month follow up intervals.

### 2.4 Patient selection:

Twenty male and female adolescents aging 18-25 year were selected to participate in the study following inclusion and exclusion criteria.

#### Inclusion Criteria:

- Highly educated volunteers.
- Patients with no smoking habits, easily contacted and available for follow-up recalls up to one year.
- Patients who didn't experience any bleaching procedures.
- Good oral hygiene.
- With discolored maxillary and mandibular anterior teeth (shade A3 or darker).

#### Exclusion Criteria:

Patients who are currently undergoing orthodontic treatment, orthopedic treatment of the jaws or psychological treatment.

- Pregnant women.
- Lactating women.
- Severe discoloration of internal tooth (fluorosis, tetracycline stains, pulpless teeth).
- Bruxism habits or had any gross pathology in the mouth.
- Patients with sensitivity equal to or greater than mild were excluded from the study.

#### 2.5 Patient's rights:

The purpose of the present study was discussed and explained in details to the patients. All steps and procedures of this clinical research were informed in details to participants involving any possible complications and how these shall be managed. Informed consents were obtained according to the guidelines of human research published by the Research Ethics Committee at Faculty of Dentistry, Tanta University.

## 2.6 Patient preparation:

Visual analog scale (VAS) was used to evaluate the degree of tooth sensitivity of each participant prior to the study [21]. Every one patient described the discomfort degree in response to air spray application when using a dental syringe with a pressure about 45-60 psi, placed at 2 mm away from labial surface of the anterior teeth at the middle-third of the teeth in each arch for 3 sec. On the opposite arch, the teeth were isolated from the air stream during sensitivity testing procedure using cotton rolls supported by the operator's finger [22].

Subjects were asked to record whether they experienced sensitivity, using the following criteria: 0 = none, 1 = mild, 2 = moderate, 3 = considerable, 4 = severe [23].

The teeth were scaled (supra-gingival and sub-gingival) using hand scalers and curettes (Prima-Dent, International, Frankfurt, Germany). Then professional teeth polishing was performed using polishing brush, mounted rubber cups and flouride free prophylaxis polishing paste to remove surface stain and plaque to assure a highly polished surface. The volunteers were instructed to rinse their mouth regularly 3-4 times per day using flouridated mouth wash [24].

## 2.7 Grouping system:

Teeth of participants were divided into two equal groups according to bleaching materials used following:

### GP I:

Maxillary anterior teeth were received (In-Office) bleaching material (N=20):

**Subgp A:** the color measurement was performed using spectrophotometer (N=10).

**Subgp B:** the color measurement was performed using shade tab (N=10).

### GP II:

Mandibular anterior teeth were received (Over-The Counter) bleaching material (N=20):

**Subgp A:** the color measurement was performed using spectrophotometer (N=10).

**Subgp B:** the color measurement was performed using shade tab (N=10).

## 2.8 Colorimetric Evaluation (Measurements):

The teeth color was measured using a contact-type intra-oral spectrophotometer (Vita Easy shade V, VITA Zahnfabrik, Bad Säckingen Germany, S/N: H50000 V503i.) based on the CIE L\*a\*b\* color space system and standard Vita classic Shade Guide (Vita Zahnfabrik, Germany) that are arranged from B1 to C4. The color shade match was performed in standardized conditions using the same light source, the same time of day along the evaluation periods before any treatment, directly after bleaching and in 3 months intervals for a year postoperatively.

Standardized photographs (Nikon KCC-REI-NKR-D5100(55/80 mm zoom lens, Thailand) were taken to record the achieved results. These were taken 30 cm away from the patient at the level of occlusal plane under ordinary white fluorescent light (without using the dental unit light).

### 2.9.1 For group I:

Partial isolation was done by using lip retractors, cotton rolls and saliva ejectors. Protective creams, such as Orabase or Vaseline, were applied to the surrounding oral mucosa to prevent chemical burns by caustic oxidizers of the bleaching materials. The gingival protector was applied directly on the labial and lingual gingival tissues to cover about 3-4 mm of the gingival and 0.5-1 mm of the teeth. Then light curing of the resin was performed using a light-emitting diodes curing unit (Nikon KCC-REI-NKR-D5100(55/80 mm zoom lens, Thailand.) with a light intensity of (1200 mW/cm<sup>2</sup> output). Curing was performed in standard mode for 30-40 seconds in an arching movement over the material.

Avoid injection of a local anesthetic solution or prescribe any oral or injectable analgesics. Protective sunglasses (safety goggles) were positioned over the patient's and the operator's eyes for protection against irradiation from the lamp (same manufacturer of glasses and lamp).

The bleaching gel was kept refrigerated between (4-12<sup>0</sup>C) and allowed to reach the room temperature before use. The mixing tip was attached to the top of dual- syringe of the WHITE smile LIGHT WHITENING AC gel. The flow of the gel was verified prior to intraoral application. The in-office bleaching gel (32% hydrogen peroxide) was applied directly over the labial surfaces of the maxillary anterior teeth with a thickness about 1-2 mm (figure-1). The whitening lamp of the LED bleaching device (BT Cool Plus, Taiwan.) was used and employed 4 LEDs each with a wavelength of 430-490 nm and irradiance of 350 mW/cm<sup>2</sup>.

The lamp was placed close to the patient's mouth during the gel application, then turned on for 15 minutes (this process was repeated three times and each time the bleaching gel was refreshed with a new one) for total application time 45 minutes. The heat source was then removed and teeth were allowed to cool down for at least 5 minutes. The gel was gently removed using suction and followed by washing for about 1 minute with warm water. Then, gingival protector, lip retractor and cotton wool were removed. A desensitizing gel was applied to the bleached teeth surfaces and left undisturbed for 10 minutes.

### 2.9.2 For group. II:

Each participant in this group received seven disposable whitening strips. Crest 3D White Luxe Supreme Flex Fit White strips are thin, flexible

polyethylene strips that are coated with 5.3% hydrogen peroxide infused gel.

The volunteers were instructed to perform proper oral hygiene with dental floss (Oral-B® Complete SATINFLOSS®, Procter & Gamble, UK) and a tooth brush prior to the application of the whitening strips. They received oral and written instructions according to the manufacturer's recommendation about how to use the whitening strips. Furthermore demonstration was done to aid participants in the first trial of application of strips.

First, they peeled Crest 3D White Luxe Supreme FlexFit Whitestrips from backing liner. Then, slowly stretched the strip in controlled manner to obtain a uniform strip and applied the gel side of the strip on labial surface of the mandibular anterior teeth, stretching is optional, the product works as well if they choose not to stretch it according to manufacturer's instructions. After that, they did align the straight edge of strip with the gum line and pressed gently with finger pads for 2-3 seconds onto front side of teeth to conform the shape of their teeth. The strip was then

folded back to cover the lingual surface of the teeth (Figure-2).

These strips were applied in front of mirror or by the aid of another person. They were used for one hour per day, removed and discarded. This procedure was repeated for one week. The patient was instructed not to eat, smoke, sleep, or even drink (With the exception of water in very small amount) while wearing the strip.

All participants of both groups were informed that cold sensitivity is common, especially during the first 24 hours after treatment. Also, they were instructed to use a fluoride rinse twice daily for 2 weeks and brush their teeth regularly, using fluoridated toothpaste (Sensodyne toothpaste with Fluoride, Glaxo Smith Kline).

The patients were oriented about their diet in order to avoid acid and/or high colored foods and beverages, explaining to the patient that the demineralized bleached enamel is more susceptible to staining by pigments, which could cause undesirable color changes.



Figure-1: application of In-office bleaching material.



Figure-2: application of OTC bleaching material.



Figure-3: before bleaching.



Figure-4: immediately after bleaching.

### 3. Results

The present clinical study addressed the problem of the color stability of two contemporary tooth whitening materials [WHITEsmile. LIGHT

WHITENING AC and Crest 3D White Luxe Supreme FlexFit Whitestrips] represented at twenty patients divided into two main groups by investigating their response among different follow up periods (baseline

(before any treatment), immediately after treatment, 3m, 6m, 9m and one year).

All the data concerning the color change was collected, recorded and tabulated at different

evaluation periods (base line, after treatment, 3, 6, 9 and 12 month) thus the median values of two groups and subgroups were expressed to be statistically analyzed as represented in table 2.

**Table -2:** Median for groups.

Duration	Group I: Maxillary anterior teeth		Group II: Mandibular anterior teeth	
	Sub group A	Sub group B	Sub group A	Sub group B
Baseline	B3	B3	A3.5	A4
After treatment	A1	A1	A1	A1
After 3 months	A1	A1	A1	A1
After 6 months	A1	A1	A2	A2
After 9 months	A2	B2	A2	A3
After 12 months	A2	B2	A3	A4

To statistically analyze the color change values of the two different tested groups at each tested period, Friedman test was performed. The comparison was done at a level of 95% significance, and revealed a

significant difference in Gp I (sub gp A) as compared with other group and subgroups since P value equal 0.017 (table 3).

**Table -3:** Comparison between different durations in the same group using Friedman test and describe data using mean rank.

Duration	Group I: Maxillary anterior teeth		Group II: Mandibular anterior teeth	
	Sub group A	Sub group B	Sub group A	Sub group B
Baseline	4.08	3.55	2.88	3.33
After treatment	4.00	4.20	3.83	3.90
After 3 months	4.03	2.93	4.30	3.58
After 6 months	3.35	3.05	3.20	3.53
After 9 months	2.90	3.83	3.23	2.98
After 12 months	2.65	3.45	3.58	3.70
$\chi^2$	13.739	7.901	8.463	3.434
p-value	0.017*	0.162	0.133	0.633

To find out which period of time is responsible for that significant difference, Mann-Whitney U test was used. This analysis showed that after 9 month and after one year evaluation periods for group I was mainly responsible for this significant difference

against other evaluation periods. However the data representing color change for group II just after treatment and after 9 months follow up periods was also significantly different compared to those at baseline, after 3,6,12 months (table 4).

**Table -4:** Comparison between several durations in the sub-groups using Mann-Whitney U test.

Duration	Group I Sub GP (A VS. B)	Group II Sub GP (A VS.B )
Baseline	0.604	0.157
After treatment	0.466	0.017*
After 3 months	0.511	0.640
After 6 months	0.715	0.301
After 9 months	0.023*	0.030*
After 12 months	0.028*	0.242

To compare sub Gp A among different tested groups using the same test, a significant difference was observed in immediately after treatment evaluation period as compared with other evaluation

periods. While, for sub Gp B, after 9 months evaluation period was the main responsible for that significant difference (table 5).

**Table -5:** Comparison between several durations in the sub-group using Mann-Whitney U test.

Duration	Sub GP A Group I VS. Group II	Sub GP B Group I VS. Group II
Baseline	0.056	0.512
After treatment	0.035*	0.114
After 3 months	0.989	0.583
After 6 months	0.495	0.556
After 9 months	0.968	0.021*
After 12 months	0.301	0.495

#### 4. Discussion:

The word cosmetic is a derivative of the Greek word 'cosmetikos' and firmly speaking means a decoration. Cosmetic dentistry has become the accepted term both within professional and patient used method and is known as procedures that are provided mainly to advance the look of the teeth, mouth, and finally the face. Generally, cosmetics used around the face are provisional, superficial and transient, such as eye shadow or lipstick. They must be used every time one needs that effect. Cosmetic products do not injure or harm the surfaces on which they are located and are readily reversible in its effects [25].

Tooth-whitening (decolorization) becomes more and more popular cosmetic procedure that is generally considered attractive by people and established by the dental profession as a reasonable and safe treatment [26].

The impact of tooth whitening worldwide and dramatic growth has raised patients' alertness of the look of their smile. According to the FDA, whitening restores natural tooth color and bleaching whitens beyond the natural color [27]. Regarding the argument, there is no obvious significant difference in teeth color between females and males [28]. In the current research, the patient sex was randomly selected.

32% WHITEsmile LIGHT WHITENING AC as an in-office bleaching material was chosen, according to **Meng et al.**, [29], since it exhibits a 'milder' or even 'non-invasive' bleaching therapy. The pH =8,0 - 9,7, in the mixture may assist to avoid the irreversible changes of enamel surface. A WHITEsmile After Whitening Mousse was used as a desensitizing agent following bleaching techniques which contains 30% Xylitol, 4.2% Potassium nitrate and 1450 ppm Sodium Fluoride.

In general, natural tooth color has a powerful association with age, usually becoming darker and more yellow with advancement of age[30]. Therefore, in the present study the average age for the tested groups was limited to younger patients from 18 to 25 years who were also a common age group looking for cosmetic treatment.

In the present investigation, the instrumental evaluation was done using spectrophotometer under controlled clinical conditions which has been favored and sensible over the visual assessment since it makes the process of color measurement more realistic and practical, reproducible for quantitative evaluation of tooth color change, statistically more reliable, more accurate in obtaining the color change ( $\Delta E$ ) in numeric values (within the LCH color space system) and provides normal distribution results. In a study carried out by Kim-Pusateri, et al., [31] they confirmed that this process gives more standard and assurance results, with 96% accurateness.

With respect to the middle site of the tooth chosen in the present study, it has been described as the location that best represents the tooth material color. This is for the reason that the incisal area is most frequently translucent and is determined and affected by its background and in order to the cervical color is changed and modified by the light scattered from the gingiva [30].

Some studies have suggested that the color evaluation immediately after bleaching must be carried out with caution since tooth dehydration causes temporary color changes in teeth, especially when the bleaching gel is applied in combination with light exposure as done in the present situation. It has also been suggested that because of alterations over time, color must be checked when water uptake is completed [32]. In addition, it was concluded that in office power bleaching leads to dehydration of the bleached teeth, which interferes with the color differences evaluation [33]. In the current study, to reduce the resultant effects of whitening procedure as dehydration of teeth, the evaluation of the color of bleached teeth was accomplished 2 days after the achievement of the bleaching process rather than right away after that. Although this time is inadequate for total rehydration of the bleached teeth surfaces, there is a restriction on delaying the evaluation of the color anymore because the deterioration of whitening may take place and interfere with the accurate results in terms of color regression and the degree of whitening. This process had previously been described by **Li et al.**, [34].

Our methodology instructed the participants to use fluoride dentifrices frequently in the daily practice with the intention of assessing a supplementary source of fluoride which may ultimately contribute to remineralization of the enamel surface after the bleaching process and superficial stains removal or polishing [35]. Thus, patients were instructed to make use of a fluoride rinse twice daily for 2 weeks and brush their teeth regularly, using fluoridated toothpaste to enhance active remineralization. Besides, instructions were given to members joining this research to carry out good oral hygiene with tooth brushing and dental floss preceding the use of the whitening strips. Also, the patients were oriented about the diet so as to keep away from acid and/or high colored beverages and foods, explaining that the demineralized bleached enamel surface is more liable to staining and discoloration by pigments, which possibly will cause disagreeable changes of color [36].

There is a general belief among general population and anecdotal evidence among dentist practitioners that in-office bleaching is superior to over the counter technique. In addition, some manufacturers claim that high concentration hydrogen peroxide bleaching agents are superior and faster compared to the low concentration products [24].

On the other hand, the technology for these products allows the active ingredient to be incorporated and integrated into strips that are applied onto the surface of the tooth, which adheres to enamel, with no physical barrier [37]. This minimizes peroxide dosage and thus decreases tooth sensitivity, while reducing treatment time and making whitening more convenient. Hydrogen peroxide product concentrations vary from 5% to 14%. In the current research, the Hydrogen Peroxide concentration for the strips used was 5.3-5.6%. Many previous studies have been carried out to establish the efficacy and safety of over the counter products, as tray-delivered whitening materials, bleaching strips and whitening dentifrices [38].

In the current study, the lower jaw was chosen to be treated using OTC technique. The strips were found to contain low concentration of hydrogen peroxide which was considered a more friendly treatment. **De Souza et al.** [39] concluded that mandibular incisors subjected to in-office bleaching technique exhibited a permanent coagulation necrosis in their coronal pulp tissue. Patients should be attentive of the different treatment options obtainable for discolorations of the tooth and of course the penalty and the consequences of these.

To manage this conflict, a comparison was performed including both in-office and OTC bleaching techniques in the current research.

Currently, the in-office bleaching process was achieved using 32% WHITESmile LIGHT WHITENING AC and was repeated three times and each time the bleaching gel was refreshed with a new one for total application time 45 minutes according to **Abo-Hamara and Etman** [40] who concluded that multiple sessions are needed for obtaining optimal bleaching outcomes.

A source of light was used with the purpose to improve bleaching efficacy according to **Nutter et al.** [41] and **Henry et al** [42]. Bleaching agents were activated by different light sources, like ultraviolet and infrared lamps, light emitting diodes (LEDs), halogen curing lights, plasma arcs, and lasers (CO<sub>2</sub>, argon, and diode lasers) [43]. In the current study, LED source was used.

The underlying principle behind the role of light activation during bleaching procedure is that a small fraction and portion of light is absorbed by the bleaching product, and its energy is transformed to heat, thus improves the degradation rate of hydrogen peroxide, energizes the tooth stain molecules and results in augmented release and discharge of hydroxyl radicals through an increase in temperature (thermocatalysis) to aid the overall acceleration of the bleaching process [44].

According to the statistical analysis of the current collected data for color change values concerning group I and II, it was found that the color was effectively improved. Consequently, the null hypothesis of the current study demonstrating that the “degree of color improvement of bleached teeth in two groups is statistically the same,” was accepted. Certainly, both protocols of bleaching were efficient in promoting and creating tooth bleaching. This result is in concurrence with a preceding study carried out by **Almeida et al.** [45] who stated that the statistical difference between both methods of bleaching was not significant.

Also, the treatment times for Over-The Counter bleaching technique is extended and whitening effects depend on how much time per day the patient spends applying the technique. Also, the active ingredients in whitening agents would be important, which includes polyvinylpyrrolidone, a water soluble homopolymer. This polymer is thought to attach and take away discoloration and stains in different oral care applications and avoid stain redeposit ion [46].

The results of the current study coincided with those of **Ghalili et al.** [47] who reported that shade improvement was achieved by 2 to 12 shades after application of 9% hydrogen peroxide bleaching product over 5 days. The results of most subjects (75%; 21/28) were maintained over the 3-month period since treatment.

In the clinical circumstances, external chromogens (coffee, wine, nicotine, metallic ions) may participate in the color deterioration of whitened teeth. Nonetheless, dietary advices for preservation of the bleached condition are regularly neither given nor reported. It should be noted, certainly, that the darker the initial shade, irrespective of the variation in the natural coloration of the dentition, the more prolonged, violent and aggressive bleaching protocol is expected to be, and consequently the more injure and damage can be predictable to be done [48].

**Patel et al. [49]** stated that the color improvement in both groups is probable to be because of the dehydration of the bleached teeth which may be caused by the extended and prolonged process of power bleaching procedure.

In our study, tooth sensitivity was recorded in some cases and tissue sensitivity was avoided by gingival protector used in in-office technique and giving detailed instructions regarding techniques for over the counter products. After bleaching procedures, tooth sensitivity has been related to inward hydrogen peroxide diffusion through enamel and dentin to get to the pulp chamber. In these circumstances, this reactive oxygen species (ROS) leads to pulpitis that induces cell-release derived factors able to stimulate and sensitize pulp nociceptors [50].

Even so, in principle, if this were the whole story, the incidence of tooth sensitivity during and after the treatment has been associated with microscopic surface defects and subsurface pores in enamel but may represent as well the degree of biological damage of tooth bleaching. In fact, it has been theorized that these defects allow rapid ingress of the whitening agent to the pulp and this gives rise to different levels of bleaching sensitivity, causing reversible pulpitis and consequent teeth thermal sensitivity [51].

Previous investigations reported the incidence of sensitivity in clinical trials, some have reported severity. **Kossatz et al. [52]** reported that sensitivity related to in-office bleaching was severe enough to force participants to withdraw from their study. In the present research, no participants discontinued the bleaching treatment due to sensitivity, 100% finished the study.

On the other hand, another situation was observed concerning in-office bleaching. The major advantage of this approach was being more conservative, more effective in stain removal, significantly improved the appearance of tooth color and provided complete control on the process throughout treatment. It was also a rapid process and the results were evident even after a single intervention. Hence, in-office bleaching should be the

most commonly adapted method that the dentist utilizes [53].

### Conclusion

Vital tooth bleaching is an effective treatment modality that can significantly change the appearance of teeth. Is a great way to get a fast and immediate improvement in the color of teeth. The color improvement is superior in the in-office bleaching compared to the OTC bleaching technique.

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### Conflict of Interest

There is no conflict of interest exists.

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