THE USE OF LIGHT CURE IN BLEACHING TREATMENT

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ABSTRACT

Introduction: Dental aesthetic is an important need for many people. Tooth color is an important aspect to assess people's perception of beauty. Teeth whitening or teeth bleaching is an aesthetic treatment to alter the color of the teeth, which is in great demand by many patients. The use of light cure is thought to be able to improve the results of bleaching treatments. Objective: the aim of this study was to conduct an integrative review with scientific evidences relating to the use oflight cure to improve bleaching treatment results. Methods: analyzing journals from the Google Scholar, National Library of Indonesia, EBSCO, PubMed, Cochrane database. The results analyzed were the value of color change in tooth after the use of light cure in bleaching treatments. Conclusion: this review reveals that the use of light cure can improve the results of bleaching treatments.

Keywords: Bleaching, Light Cure. Dental Treatment

1. BACKGROUND

In many metropolitan cities across the globe, dental esthetic is an important need for many people. Tooth color is an important aspect to assess people's perception of beauty and dental aesthetic treatments are highly demanded by patients nowadays. For example, in the US it has been reported by a survey in 2018 that 41% people are not confidence with their own smile, 55% people want a smile like fashion models, and 60% people want and cleaner teeth. This is because p&nts considat}ut to have an attractive smile is synonymous with health, good appearance, professional and social benefiE Datal bleaching is highly demanded treatment by p&nts nowadays. Com ared to other restorative treatmans, dental bleaching is the most conservative dental treatment. A survey in UK, Spain, and Saudi reported that 28-34% patients want whiter teeth and willing to do bleaching procedure. A study in Malaysia md UK also reported that dental bleaching is the **nost demanded** treatment by patients in 2017. More than I million people across US spend up to 600 million dollars evay year for dental treatment. In 2014, 98% of Australias hi)' whitening toothpaste every 6 months. 'The markd for whitening products and treatments are expected to rise tmtil 2024. Most patients want whiter, easier, and faster bleaåing treatment. In-Offce bleaching technique is suitable for this demand. In this technique an insüuman known as light cure is frequently used. The use ofsud' insuuments is thought to increase the **effectiveness**of treatment, although still highly debated. Some researchers believe that the use of light cure does increase the effect of bleaching ü•eatment, while others don't beliege so, some even consider it as marketing strateg to sell more products.

ne aim of this study was to conduct an integrative review with scientific evidences relating to the use of light cure to impove bleaching trea ment lesults.

Dental bleaching

Dennl bleaching is a treatment that involves oxidative chemicals which then alters the way light absorbed and reflected from material structure of tooth, thus increasing and changing the color of the tooth into whiter color. Other procedures to alter tooth color that offered by dentists are veneers and crowns, but often tooth discoloration can be fixed just by the bleaching procedure. Dental bleaching is more conservative, easy to do, and cheap compared to veneers and crowns.

Bleaching materials

Active material that is generally used in dental bleaching is peroxide compounds. Hydmgen peroxide, sodium perborate, and carbamide peroxide are the three most used peroxide compounds in dental bleaching. Hydrogen peroxide and carbamide peroxide usually used in extemal bleaching technique, whilst sodium perborate usually used in intemal bleaching. Natrium perborate and carbamide peroxide will decompose into hydrogen peroxide when in-contact with water medium.

I. Hydrogen peroxide (HA)

Hydrogen peroxide generally used in in-omce and at-home bleaching. In-omce bleaching technique use higher concentrated hydrogen peroxide (25% to 38%) than in at-home bleaching (3% to 7,5%). Hydrogen peroxide is a strong oxidative material available in many concentration, but stable concerüation of 30% to 35% are frequently used. This material must be handled carefully because of the unstable nature ofperoxide, losing oxygen molecules in fast rate, and able to explode if not stored in chilled or dark container. Hydrogen peroxide is able to bum organic tissue when contact, so must be used carefully not to contact with any oral soft tissue.

2. Carbamide peroxide (CH6N 03)

Carbamide peroxide or often called urea hydrogen peroxide available in white crystal powder form which contains 35% hydtogen peoxide. Carbamide peroxide will fom hydngen pencide and urea on liquid solution.

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This material often used in at-home bleaching technique with concentration of 10% to 20% (equivalent to 3,5% to 6,5% hydrogen peroxide). 10% carbamide pe10,xide will split into urea, ammonia, carbon dioxide, and 3,5% hydrogen peroxide. Th'S material is only used in external bleaching and able to damage surrounding hard and soft tissue. Carbamide peroxide can also affect composite resin bonding strength, thus the use ofcarbamide peroxide must be closely watched by dentist.

3. Sodium perborate (NaB03)

Sodium perborate is available in many toms. Fresh sodium perborate contains around 95% perborate which equivalent to 9,9% oxygen. Sodium perborate has stable nature while dry, but in acidic state, warm air, or water, sodium perborate will split and create sodium metab01üte, hydmgen peroxide, and new oxygen molecules. It has many foms, which are monohydrate, trihydrate, and tetahydrate. fie three forms are diflZrentiated by their oxygen content, and thus their ability of whitening is also different. Sodium perborate is easier to handle and safer than hydrogen peroxide, and so this material is more often used in intracoronal bleaching.

Bleaching methods

There are 2 knoyn bleaching methods, intracoronal or intemal bleaching and extracoronal or extemal bleaching:

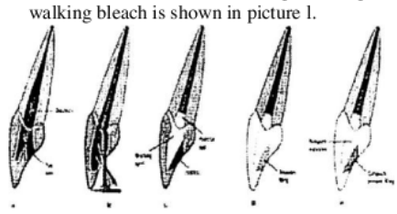
1. Intracoronal or internal bleaching

Root canal traunent may cause tooth discoloration fiom within the tooth. Intemal bleaching technique is chosen ifthe dentist wants to maintain the tooth stmcture. 'Ihis bleaching method is more conservative compared to invasive treatments such as veneer, full crown, but the long tenn results are reported to be low. The indications for intemal bleaching are: (l) discolorations that resulted from within pulpal space; (2) dentin discoloration; (3) discolorations that cannot be corrected by extemal technique. The contraindications are: (l) superficial enamel discoloration; (2) enamel defect; (3) severe dentin loss; (4) presence of caries; (5) discolored proximal composites (unless to be replaced after bleaching). lhere are 4 Imown techniques within intracoronal bleaching:

(l) Themocatalytic technique which uses 30% to 35% natrium perborate into the pulpal space and then activated by heat. This technique is no longer used nowadays and has potential to cause extemal cervical root resorption from the result of imitation on cementum and periodontal ligament because of the combination between chemicals and heat (Madison and Walton 1990).

(2) Walking bleach technique which introduced by Nutting and Poe in 1961. nis intemal bleaching technique is the most used until today because of its safer and faster procedure. This technique requires hydngen peroxide or natrium perborate mixed with water,

heat is not used in this technique. The procedure of walking bleach is shown in picture l.



Picture l. Complete procedure of walking bleach

(3) Combination technique where walking .bleach technique is first used and then finished with ex'ternal bleaching technique. This technique uses sodium perborate for the internal bleaching and 35% hydrogen peroxide as extemal bleaching.

(4) Ultraviolet photooxidation technique which uses ultraviolet light. 30% to 35% hydogen peroxide is placed inside pulpal space and then activated by ultraviolet light for 2 minutes, thus oxygen will be released as in thermocatalytic technique. This technique is rarely used and not recommended because it takes longer, uses higher concentration of hydrogen peroxide, and has not been proved to be more effective than walking bleach technique.

2. Extracoronal or external bleaching

Extemal bleaching can be used to whiten vital or nonvital tooth. Generally, in extemal bleaching, hydrogen peroxide with the concentation of30% to 35% is used and then activated by heat from a light source, heat conductor device, or laser to accelerate and to improve the result of bleaching process. There are 3 known techniques in extemal bleaching:

(1) In-omce bleaching is best used to con•ect severe discoloration and uncooperative patients. Compared to at-home bleaching, in-omce bleaching has several advantages, which can be directly supervised by dentists, low chance ofaccidental swallowed peroxide, and fewer treaunent duration.

(2) At-home bleaching uses lower concenu•ation of peroxide. 10% to 20% carbamid peroxide is often used in this technique (equivalent to 3,5% to 6,5% hydrogen peroxide). This technique can be done at home by patient themselves, but must still be supervised by dentist on regular visits. The bleaching material is placed onto special appliance that can be inserted into patient's mouth evety night for 2 weeks. Compared to in-omce bleaching, it can be done by patient themselves at home, safer because it uses lower concentration of peroxide, minor side effects, and cheaper, but the success of this technique is heavily depends on the patient's cooperativeness.

(3) Over-the-counter bleaching products for the few yeas have increased in popularity. These products contain 3% to 6% hydrogen peroxide and can be

used brushes, strips, and mouth trays. Bleaching materials are available in gels, powders, and whitening tooth pastes. These products must be used in caution because some of them are not listed in food and drug administration.

Bleaching mechanism

The mechanism of bleaching remains unclear at present. However, it is generally believed that flee lüdicals produced by hydrogen peroxide maybe responsible for bleaching effects and they are similar to that in textile and paper bleaching. Chromophore theory first intmduced by Albers in 1991 is commonly used to explain bleaching mechanism. Hydrogen peroxide diflüses into email and dentin, and because its nature tp be unstable, splits into hydroxils (HO'), peridroxil radicals (H02•), superoxide anions (Or), and reactive oxygen molecules (O) which will then break long chained molecules into shoner chains. These shoner molecule chains will reflect light differently compared to longer molecule chains, and thus the tooth looks brighter.

Light cure

Light cure in dentisüy is a device that is used to polymerized composite resin. These devices also used on dental materials that need to be activated by hear or light. Common light cute devices that is used in dental clinis are:

1. Ultraviolet

   Ulüaviolet curing light was the first to be used in composite resin polymerization. The wavelength ofthis device is in the rmge of364-367 nm. It was later found dut this light could cause damage to the eyes, causing and hann nonnal microflora inside the oral cavity. Since then this unit is no longer used in clinical practice and are no more available in the market.

2. Tungsten halogen

   This light cure unit has been innovated to place the ultaviolet light curing unit Most of the units use tungsten filament halogen lamps that incorporate blue filter. This unit is able to produce light rays with the wavelength of 400-500m and is able to produce energy level up to 300mV. The amount oftime requil?d to cure the composite is 40 seconds. High perfomance halogen curing light has been developed to overcome the problem of conventional halogen light that requires longer time to cure orthodontic icomposites. It has an 8 mm light guide, which generates full spectrum light filtered as blue with a range of 400 to 505nm. It cures orthodontic composites in eight seconds. This unit also has boost mode, which increases the light output to 1000mW/cm^2. This will allow the composite under metal bracket to be cured in five seconds.

3. Plasma arc

   This light cure unit has been developed afterthetechnolog used by The United States Nasional Aeronautics and

   1.

   Space Association in aeronautical engineering. Plasma arc light cure unit has filters that are able to nan•ow the spectrum of visible light to a band centerd at 470nm. It has two electrodes with a large voltage potential that ate able to ionize xenon plasma gas to emit the light, and thus the lights have an energy level of900 mV. which is much higher than halogen lights. Illis unit will take only two seconds to cui? orthodontic composite.

4. Blue Light Emitting Diode (LED) 1he breakthrough in semiconductor technology has led to the use of LED in curing light cured composite resins. This unit uses indium gallium nitrate technology. As cunent flows thmugh the semiconductor chips, electrical eneagies convened directly into light, resulting into stable, efficient. and long lasting output of blue light with little energ emitted as heat. The spectrum of light produced is in the lange of 430 to 490nm. It is able to cure onhodontic composite in between 10 to 40 seconds.

5. Argon laser

   Argon laser curing unit has utilized the laser technoloy which provides sources that emit high intensity light within the energ band required by the initiator in light curd composite resins. Argon laser emits bluegreen light spectrum with the wavelength range of 454-496nm. Argon laser's waves are coherent. thus the photons are in phase with one another and do not collide with each other as in other light cure units. The time required to cure orthodontic composites is five seconds.

Light cure mechanism

Lights from light cure units give enery in specific spectrum. Photoinitiator molecules inside composite resin or other materials will absorb the energ and initiate chemical reaction releasing free radicals, thus the polymerization process can happen. This process is known as light polymerization.

2. METHODS

This literature review was made by analyzing refernce sources with keywords of bleaching, light cur, and dental tratment from joumals and textbooks which can be accessed from Google Scholar, PERPUSNAS RI, EBSCO, PubMed, and database. The referenced joumals are accredited and unaccredited case controls, case reports, experimental and descriptive from the year 2010 2020.

3. DISCUSSION

There has been a lot of research on the use of light cure in bleaching Ueaünent, and also a lot of debate along with it. Bhutani N, et al (2016) in their study about evaluation of bleaching efficacy of 37,5% hydrogen peroxide on 3() human teeth using halogen, laser, and no light activation revealed that the group of teeth receiving bleaching procedure with halogen light activation

produced the whitest teeth, followed by laser activated group. and lastly the ne light activation group right after the bleaching pmcedure. There was significant change of color difference ri t after, I, 2, and 3 weeks bleaching procedure between halogen activated group and control group, and Éetween laser activated group and control group. However, there was no significant dilTerence between halogen activatc•d group and laser activated group

as shown in table 1.

Table 1. Intra and inter group mean shade values comparison

Period	No Light	Ilalogen activated	Laser activated
Before Bleaching	13,70±3,09	13,30±2,45	13,20±2,36
Post Bleaching	9,40±2,59	4,90±3,38	5,60±3,41
1 week	10,30±2,79	4,80±2,53	6,30±3,30
2 weeks	12,20±2,66	5,80±2,35	7,30±2,58
3 weeks	12,20±2,66	7,30±3,06	8,30±3,40

Halogen activation was able to produce the brightest bleaching result. This might be because of the difference in the power density of both activation sources, leading to variation in the degree o heat produced in the bleaching gel which in tum enhances the decomposition ofhydrogen peroxide. Durubility ofbieaching results was found to be maintained throughout. purability of bleaching results was found to be maintained throughout the trial period of 3 weeks for halogen actiyated group. However, Ibr laser activated group, the effect ofbleaching therapy diminished overa period of2 weeks d for no light activation group, the effect lasted no longer than a week after bleaching.

This result is similar with Alomari Q and Daraa E (2010), which they reported in their study comparing efficacy between four different methods of bleaching activation (no light activaiion, halogen, LED, and metal halide). They reported th t halogen activated bleaching procedure was able to produce the brightest teeth. However, LED and metal halide activated bleaching procedure did not show significant change compared to no light activation grou . This might be because LED and metal halide light don't have enough enetgv, and so not much heat is transferléd into the bleaching materials to accelerate the decomposition of hydrogen peroxide. All groups relapsed after I month of trial period and did not show a significant color dilTerence between each groups. The writer concluded that Ithe use of halogen blue light in bleaching procedure wak only effective for short tenn result and did not affect long term result.

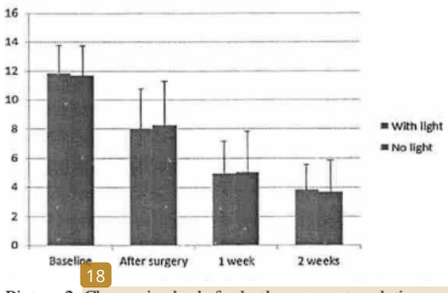
Kwon SR, et al (201B) did a study about the efléct of light activation in bleaChing pmcedule on different artificially stained teeth. This study concluded that the use of LED was able to produge brighter teeth than control group, especially on yelloW-stained samples. This might be because the LED that was used in the study was set to high intensity (466 nm, 190 !üW/cm^2), and so was able to produce enough enet&Y to accelerate the decomposition of hydrogen peroxide. fie yellåw-stained samples showed a

better etléct in the context of light activation than the nonstained and blue-stained samples, this might be because the yellow stain might be better at absorbing eneæy transiénvd from the blue light soutce and thus may be susceptible to tooth whitening by hydrogen pemxide. Yellow and orange stains have been repotted to æspond well to tooth whitening. whereas green-blue stains have not.

However. some studies did not find that the use of light cure improves dental bleaching result. Nutter B.L et all (2013) in their study about comparison between bleaching treatment with light activated and no light activated showed that there was no significant color change differe between the two groups. This study used 22 patients that was divided into two groups. First group with the total of Il patients was treated with light activated bleaching with 25% hydrogen peroxide. Second group with the total of I I patients was treated with no-light activated bleaching with 25% hydrogen peroxide. The color changes were measured before, right after. I, and 2 weeks post bleaching treatment. "Ille results ofthis study is shown in table 2 and picture 2.

Table 2. Intra and intergroup mean shade values comparison

Group	Before	Right After	1 week	2 weeks
Light Activated	11,86±1,99	8,03±2,76	4,94±2,25	3,85±1,68
No-light	11,70±2,02	8,28±3,05	5,04±2,77	3.72±2,13
p	0,74	0,89	0,97	0,67



Picture 2. Change in shade for both groups at each time point

According to the tesult of the study, there was no significant color difference between both groups right after, I, and 2 weeks post bleaching treatment. Both groups showed significant color change liom the initial color. 'Ihe light activated group showed lighter color change right after the procedure in comparison with the no-light group but nothing significant. "Illis study did not find that the use of light cure affect bleaching treatment result. This might be because the color measurements were done manually by operator. so the assessments are heavily depending on the experience of the operator. Secondly, the color measurements were not done in the same lighting environment, and thus it may affect the tooth color perceptions from the eyes.

A study done by Almeida LC. et al (2010) showed that the use of halogen and combination of LED with

laser did not improve in-oflice bleaching lesult. The color measurements were done before, I week, 3 weeks. I month. and 6 months after bleaching procedure with manual shade guide. during the same lighting environment. and the operators were blinded to the intervention. The halogen light that was used had the intensity of 400 mW/ cm^2, wave length of 450-500 nm. The LED had the intensity of 120 mW/cm^2 and waye length of470 nm. The laser had the wave length of 808nm and W potential. This study was ' similar to Goncalves RS, et all (2010), which also showed that the use of halogen, LED, and combination of LED with laser did not improve bleaching result. 'Ihe color measurements were done betöre, l, and 2 weeks after bleaching procedure. Both studies did the first color change measurement one week after the bleaching procedure, not right after the procedure. is because both writers believe that right after bleaching with the help of light activation was done, the teeth are in dehydrated state. Thus giving the effect of lighter colo:ed teeth. This factor might be the reason why the results were different with pævious studies.

CONCLUSION

Dental bleaching is a treatment that involves oxidative chemical which then alte:s the way light absorbed and tenected fiom material stucture of tooth, thus increasing and changing the color of the tooth into whiter color. According to previous studies, the use of light cure might improve the effect of dental bleachihg. However, its use is only able to improve shon-tem results and does not affect the long-term results. The light cure ülat might be able to improve the effect of deül bleaching must have amgh energ and wavelength to accelerate hydrogen peroxide decomposition process. Thus, the best light cure to impmve dental bleaching result is blue halogen light cure, and best used on yellow stained teeth.

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ORIGINALITY REPORT

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SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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