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Review Article

Effect of 35% hydrogen peroxide on in-office bleaching against changes in tooth enamel hardness: Literature review

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Abstract

Teeth bleaching is one of the treatments for teeth discolouration. Teeth bleaching can do in-home or in-office. The material for that use in-office bleaching is 35% hydrogen peroxide. Hydrogen peroxide is a chemical compound that is tough and has a micro molecule that can easily penetrate enamel tissue and dentin tissue. Bleaching with hydrogen peroxide in-office is now more attractive because can be faster to see the result. Bleaching with hydrogen peroxide when done repeat will make teeth more sensitive, and damage enamel tissue and dentin tissue. The objective of this study is to know the influence of in-office bleaching using 35% hydrogen peroxide on microhardness enamel. This research is made with a literature review with search engine google scholar, PubMed, and science direct. The results of 10 articles show the effectiveness of teeth discolouration after bleaching using 35% hydrogen peroxide in-office. The reduction in enamel microhardness seen using SEM, knob and Vickers is visible although not significant. Based on the literature review research that has been carried out, it can be concluded that there is a reduction in enamel hardness after the in-office bleaching process by using 35% hydrogen peroxide.

INTRODUCTION

Teeth discoloration is part of the aesthetic problem in society. Teeth discoloration can be caused by intrinsic factors (the incorporation of substances inside enamel and dentin such as *tetracyclin, imperfect dentinogenesis, fluorosis*, dental trauma and drugs) and extrinsic factors caused by agents that cause changes in enamel (cigarettes, tea, and coffee).[1]

Teeth bleaching is one of the measures taken to deal with tooth discoloration. The material commonly used for *in-office bleaching* is hydrogen peroxide.[2] Hydrogen proxide has the ability to dissociate into reactive oxygen species (ROS) which is widely used in tooth *bleaching*. Hydrogen peroxide is used for *in-office bleaching* because of its stronger properties than carbamide peroxide.[3]

The bleaching process occurs when low-molecular hydrogen peroxide diffuses through enamel and dentin, then releases reactive oxygen species (ROS) that react or bind to other weak substances. The penetration of oxidative agents in the tooth structure will damage the dye molecules so that it will give a brighter result to the tooth.

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This process is usually called a redox[3] reaction.

The high peroxide content makes the pH level of the teeth decrease so that it can cause changes in the enamel including increased roughness, decreased micro hardness of enamel, decreased strength of enamel and changes in the composition of enamel.[4] Hydrogen peroxide used in dentistry is between 5% to 38%. The process of *bleaching* teeth produces the effect of reducing the hardness of enamel, increasing tooth sensitivity and erosion.[5]

Research conducted in 2015 by De Paula using 35% hydrogen peroxide in *in-office* bleaching, teeth in contact with saliva can cause demineralization and dehydration processes after a few days *post-bleaching.*[6] In *in-office* bleaching, the duration of contact with bleaching agents has a greater effect than the concentration of bleaching agents. One of the effects that appears after *bleaching teeth* is a decrease in the level of micro-hardness in enamel.[7] Enamel hardness can be tested with Knoop or Vickers, SEM (*Scanning Electron Microscopy),* and EDS (*Energydispersive X-ray Spectroscopy).*[8]

METHOD

The research is in the form of *literature review* by collecting a number of data on 35% hydrogen peroxide in *in-office bleaching* related to changes in enamel hardness that have been carried out in previous studies. The research results listed were obtained using keywords in each *database* (*google scholar, PubMed.* And *science direct)* according to the problem of the research problem.

The results of all *databe* obtained 489 articles which were then *screened* according to the inclusion and exclusion criteria from 2011-2021, accessible *ful text,* in the form of research articles and using English and Indonesian. Furthermore, an assessment of the feasibility of a copy of the *ful text* is carried out where a *review* of the entire article is carried out and then it is calculated with *a critical appraisal* to find out whether the relevant article is used to answer research problems that have been formulated in accordance with the research objectives. The article was analyzed for research problems and then concluded.

RESULT

Based on the search results of 3 *databases*, namely *Google scholar, PubMed, and science direct,* there are 10 articles related to 35% hydrogen peroxide. The results of 10 articles show the effectiveness of teeth discoloration after bleaching using 35% hydrogen peroxide *in-office.* The reduction in enamel micro hardness seen using SEM, knob and *Vickers* is visible although not significant. The reduction of enamel micro hardness can be caused by several things.

DISCUSSION

The *in-office bleaching* process on teeth has been carried out in the past 100 years ago. The *in-office bleaching* method is currently widely practiced because of its advantages such as, it does not require a long time, and can minimize taboos in food consumption. A commonly used material for *in-office bleaching* is usually hydrogen peroxide. Some also use non-additives in the *bleaching process.*[9]

Hydrogen peroxide is a strong oxidizing agent and can cause the formation of other highly effective bleaching agents such as perihydroxyl anions (HO) and hydroxyl radicals (OH-). Hydrogen peroxide material can cause burns or irritation to the gingiva if it accidentally hits soft tissues, because hydrogen peroxide has unstable and hard properties.[10]

In the redox reaction process, hydrogen peroxide which has small molecules can easily diffuse into the enamel matrix layer. The free radicals then interact with organic molecules to achieve stability. The

effectiveness of *bleaching* is influenced by several things such as stains on teeth, pH, length of application time, temperature, hydrogen peroxide concentration, additives (rsa enhancing agents), and other factors (age and gender).[11]

Hydrogen peroxide is active at an alkaline pH. However, a high pH can cause damage to the surface of tooth enamel.[5] The temperature setting in the *in-office bleaching* process has an effect on removing ROS so that hydrogen peroxide performance increases up to 2x.[5] Teeth bleaching with pH 5, pH 7, pH 8, pH 9, and pH 10 resulted in, teeth bleaching with pH 10 visible results were very significant, but side effects that appeared such as a significant decrease in enamel surface hardness were also.[12] The length of time of application also affects the *bleaching process.* Teeth repeated 3x15 minutes using 35% hydrogen peroxide produce a brighter tooth color than using 40% hydrogen peroxide once repeated.[13]

Some of the effects arising from the *bleaching* process using 35% hydrogen peroxide include increasing tooth sensitivity, erosion, changing the hardness of enamel, hard tissue structure, and reducing micro hardness in enamel. The change is due to the demineraly process caused by redox reactions.[14]

The reduction in enamel hardness seen using the vickers tool, the presentation of micro hardness in enamel ranges from 22.1 to 0.4 values. The use of 35% hydrogen peroxide in *in-office bleaching* results in a change in the structure of enamel hardness seen using SEM. Side effects of *bleaching* can be minimized by using desensiting materials. The use of LEDs in applications can also minimize side effects that occur in teeth.[15]

The *bleaching* process begins with a subjective and objective examination and then determines the diagnosis of treatment and documentation before treatment. The patient is explained to be the cost and time of treatment, then the patient is instructed to fill in the *informed concent*. The installation of a *check rectractor* is done to protect the lips and as a marker to facilitate the part to be treated. Prosilaxis actions using *brushes* and *pumice* are performed on the teeth to be *bleached*. This action is useful for removing debris or dirt that is still attached to the teeth. The initial color of the teeth is assessed First use the *Vita Shade Guide* and the patient is educated to keep the mouth open during the procedure. *Cotton rollers* are applied along the tooth fomix to be bleached. The application of *opal dam green* is 4-6 mm long and 1.5-2 mm thick on the gingiva of the cervical part of the tooth to be bleached. Irradiation with *light curing* is carried out for 20 seconds in each jaw. Bleaching material is applied to teeth 0.5-1 mm thick on the labial surface then incisal. Apply for 20 minutes until the desired color is reached.[16]

*The bleac*hing material is cleaned by *disuction* and using *cotton pellets,* after which the patient is instructed to gargle with warm water. After all the procedures are performed, the color of the teeth is checked again using the *vita shade guide* and documentation is carried out again after *bleaching.*[16]

CONCLUSION

Based on the *literature review* research that has been carried out, it can be concluded that there is a reduction in enamel hardness after the *in-office bleaching* process by using 35% hydrogen peroxide which is influenced by several factors, namely, the pH level of the hydrogen peroxide content, the size of the hydrogen peroxide presentation content, the length of application time, the number of repetitions and temperature.

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