CONSEQUENCES OF TOOTH BLEACHING ON DENTAL TISSUES AND COMPOSITE RESTORATIONS: LITERATURE REVIEW

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ABSTRACT

The objective of this review article is to abridge all the available information regarding the Mechanism of tooth bleaching and their consequences on dental soft and hard tissues structures, physical properties morphology and color of composite restorations. The controversial reviews regarding the effects of dental bleaching agents were reviewed. Information from the original scientific full papers and reviews listed in Google scholar PubMed or Science Direct were included in this review. Bleaching may apply an adverse influence on composite restorations. It is advisable to reduce the usage of bleaching products where possible.

Key Words: Vital and non vital bleaching, composite restorations, tooth structural alteration.

INTRODUCTION

To achieve an efficacious and potent tooth whitening method, the history of dentistry is comprised of many attempts. Bleaching of non vital tooth using chloride of lime was started in 1948. Many recent reviews highlighted the prolonged victorious history of bleaching Vital and non vital tooth. The use of hydrogen peroxide and there precursors, like carbamide peroxide or sodium perborate for brightening discolored teeth has become a well known treatment option. According to a recent published review Bleaching vital tooth is relatively safe in terms of possible peril for the modification of dental hard tissues. Vital tooth bleaching is not regarded as creating macroscopically visible defects. Numerous studies suggested that many bleaching agents such as peroxides, when used in relatively increased concentrations on vital tooth surface, it unveil microstructural changes of dental hard tissues. Electron Microscopy revealed a slight reduction in toughness and microhardness due to the bleaching of dental hard tissues. Apart from the effects of bleaching agents on to the dental hard tissues, many clinicians indicate the effects of these bleaching agents on the dental restorative materials.

METHODOLOGY

The controversial reviews regarding the effects of bleaching were identified through database searching. Articles were identified using pubmed and embase data base for in vitro and in vivo studies pertaining to the role of Consequences of Tooth Bleaching on Dental tissues and Composite Restorations. All Abstracts reviewed from which duplicates were excluded. A total of 58 unique peer reviewed articles that were published in English language were screened. Out of which 17 irrelevant articles were excluded. Full texts articles assessed for eligibility and are included in this review. Key words used were: Vital and non vital bleaching, composite restorations, tooth structural alteration.

Kashima-Tanaka et al stated, In-office and home bleaching gels contain hydrogen peroxide or (precursor of H₂O₂) as an active ingredient in concentrations ranging from 3% to 40% of H₂O₂. Hydrogen peroxide bleaching generally proceeds via the perhydroxyl anion (HO₂⁻). In other conditions free radicals may forms, for example, homolytic cleavage of either an O–H bond or the O–O bond in hydrogen peroxide give rise to H + OOH and 2 OH which is hydroxyl radical. Formation of these free hydroxyl radicals has been shown to increase in the presence of light as in photochemical reactions. Minoux and Serfaty proposed that these free hydroxyl radicals (HO·), perhydroxyl radicals (HOO·), perhydroxyl anions (HOO⁻), and superoxide anions (OO⁻), which are formed by hydrogen peroxide eventually attacks
the organic pigmented molecules in tooth enamel by attacking double bonds of chromophore molecules within tooth tissues.\textsuperscript{9}

In recent years, amorphous calcium phosphate (ACP) has been incorporated to some of the tooth whitening products, in order to reduce sensitivity and to reduce the demineralization of enamel through a remineralization process after whitening treatments. A study in 2012 by Berger et al., proved that the addition of ACP did not reverse the effects of bleaching treatments.\textsuperscript{10}

**CONSEQUENCES OF BLEACHING SOFT TISSUE EFFECTS**

Barghi and Morgan\textsuperscript{11} reported that Irreversible soft tissue burns can be easily produced by using powerful in-office bleaching (30-35\% hydrogen peroxide) that changes the color of soft tissue to white. Limiting or excluding the exposure to the bleaching agent with application of antiseptic gel can readily revert the color of tissue to normal the burns.

**CONSEQUENCES OF DENTAL BLEACHING ON DENTAL HARD TISSUES**

**Enamel**

Few studies by Cadenaro et al\textsuperscript{12}, Smidt et al\textsuperscript{23}, Sun et al\textsuperscript{14} reported that dental bleaching agents does not significantly affect enamel surface. Abouassi et al., demonstrated morphological alterations in the bleached enamel surface: Bleaching of enamel results in formation of enamel depressions, porosities in enamel and marked increase in the depth of enamel grooves.\textsuperscript{15} Many other studies investigated the effects of bleaching on enamel morphology and the surface texture. Morphological changes of the surface enamel will subsequently increase porosity of the superficial enamel structure with further demineralization and decreased concentration of enamel proteins, degradation of enamel organic matrix, modification in the calcium/phosphate ratio, and calcium loss.

Sa et al\textsuperscript{16}, Xu et al\textsuperscript{17}; Azrak et al\textsuperscript{18}; Smidt et al\textsuperscript{19} Further reported that Bleaching agents are chemically active components that are able to induce considerable structural alterations in human dental enamel. Azrak et al\textsuperscript{20} Marked changes in the enamel surface were observed after 28 hours of bleaching. Hegedus et al\textsuperscript{21} after using 10\% carbamide peroxide and 30\% hydrogen peroxide, He found that the enamel surface became more uneven and has much irregular surface resulting in more deeper surface grooves.

Azrak et al\textsuperscript{22} conducted an in vitro study. He assessed the effects of bleaching agents on eroded and sound enamel specimens. Enamel specimens has been used which were prepared from human teeth. 7.5\% or 13.5\% hydrogen peroxide or 35\% carbamide peroxide, ranging in pH from 4.9 to 10.8 was used as an active ingredient. Using an optical device he measured surface roughness of all enamel specimens. Results indicated that exposure to a bleaching agents with a high concentration of peroxide or an acidic pH can provoke surface roughness of sound or eroded enamel. Cadenaro et al\textsuperscript{23} conducted an in vivo study to determine the various effect of a hydrogen peroxide in-office bleaching agent on enamel surface. Results demonstrated that there was no change in enamel surface roughness even after multiple applications of 38\% hydrogen peroxide in-office bleaching agent.\textsuperscript{17}

Xu et al\textsuperscript{24} investigated the influence of pH values of bleaching agents on the properties of the enamel surface. He used four groups treated with 30\% hydrogen peroxide solutions at different pH values: 3.0, 5.0, 7.0 and 8.0 respectively. He detected obvious enamel surface alterations in the neutral or alkaline bleaching solutions. Furthermore, de Arruda et al\textsuperscript{25} studied the microhardness of enamel after using 35\% hydrogen peroxide and concluded that 35\% hydrogen peroxide causes reduction in hardness in the enamel surfaces.

**Dentine**

Very little has been published in literature regarding the consequence of bleaching agents on dentine. Faraoni-Romano et al\textsuperscript{26} conducted a study to find out the effects of low and highly concentrated bleaching agents on microhardness of root dentin and proved that bleaching readily affected root dentin in terms of microhardness. In addition to that, Engle et al\textsuperscript{27} investigated the effects of bleaching agents and, erosion, on dentin. They indicated that bleaching with 10\% carbamide peroxide might change dentin’s abrasive wear, depending on erosive and abrasive challenges.

**CONSEQUENCES OF DENTAL BLEACHING ON COMPOSITE RESINS**

Tuker et al\textsuperscript{28} Bailey et al\textsuperscript{29} concluded in their studies that 10-16\% carbamide peroxide bleaching gels may lead to a slight increase in surface roughness and amount of porosities of microfilled and hybrid composite resins. However, when surface reflectance was analyzed the study showed significant changes in microfilled and hybrid composite resins after application of highly concentrated tooth bleaching agents containing 35\% hydrogen peroxide. Author also stated that these alterations in surface divulge more tenuous alterations in the surface and immediate subsurface.

Hannig et al\textsuperscript{30} used the knoop hardness test and reported a significant decrease in both superficial and deep surface hardness of bleached composite resins. Results were also related in regard to the high oxidation and degradation of composite resin matrix While...
using 25-35% of hydrogen peroxide consistently reveal that it notably reduced the bond strength of composite resins, when applied after a day of completion of tooth bleaching regime. It remarkably reduced both the tensile and shear bond strength of all the composite restorative material. Apparent changes in the color of nano hybrid composites when they were bleached with 15% carbamide peroxide. 31

Hubbezoglu et al 32 reported that color changes occur only in case of low density resins (microfilled composite resins) when a significantly high percentage of hydrogen peroxide is applied i.e. 35%. He further suggested that the alteration and instability in color of composite resins is associated with the oxidation of pigments present on the surface together with amine compounds. Yu et al 33 compared the properties of bleached and unbleached composite resins and concluded that staining of bleached resins occur more easily than un bleached resins because of surface alterations. Interestingly White et al 34 reported no increased microleakage rates, at margins of enamel. He found that bleaching teeth with 20% carbamide peroxide on composite restoration (class I) did not affect the occlusal margins of and did not cause any microleakage. Ajami et al 2012 35 recently evaluated the consequences of three different mouthrinses on microleakage of composite restorations after bleaching with 10% carbamide peroxide and finally concluded that using some mouthrinses, after bleaching can result in microleakage of resin composite restorations.

Pulpal Penetration

It was ascertained that external bleaching with 30% \( \text{H}_2\text{O}_2 \) or 15-35% carbamide peroxide gel at significantly increased levels, will penetrated into the pulp chamber in teeth with restorations placed in enamel. 36 It is not the case when applied on sound tooth. This is true in case of all those restorations that has been fabricated with composite materials. 37 Moreover, it was reported that when high levels of concentrated carbamide peroxide gels (35%) were compared to reduced levels i.e. 10%, it showed that high level of peroxide has much greater chances of penetration in to the pulp chamber while low concentration of peroxide gels are less likely to penetrate. 38

CLINICAL CONSEQUENCES

The above mentioned studies accentuate that both the pre- and post-operative bleaching procedures may adversely affect marginal seal and integrity of composite restorations. Furthermore, the margins of composite restorations could be noticed as it serves as a possible visible pathway facilitating hydrogen peroxide and other bleaching agents. 39

Pulpal Penetration of hydrogen peroxide is responsible for pulpal reactions, including hypersensitivity. 40 It is necessary to examine the restorations meticulously before starting a dental bleaching therapy and renew insufficient pre existing fillings if any prior to bleaching in order to achieve an optimal seal of the pulp chamber and eventually decreasing the chances of adverse effects. 41

RECOMMENDATION

It is highly recommended to delay the placement of restorations after termination of dental bleaching therapy for at least 1-3 weeks. Furthermore, bleaching therapies with hydrogen may have a negative effect on restorations and restorative materials as shown in numerous in vitro studies. Nevertheless, further investigations are necessary to elucidate these aspect more precisely. 42

CONCLUSION

This review article is provided to help clinicians improve their information and understanding of the controversial issues regarding the consequences of bleaching on teeth, resin composite, and bonding, to help reduce the risks to patients. In order to minimize the risks, the involvement of dental professionals, and the reduction of overused of bleaching products are necessary.

Inclusion to that interval of 2 weeks post-bleaching procedure is found to be adequate to avoid adverse effects on the polymerization. 43 Finally, Clinicians must inform their patients about all the possible changes that can occur on their dental restorations during bleaching procedure.

REFERENCES

Consequences of tooth bleaching on dental


