The role of Antioxidant in Restorative Dentistry

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Objectives

In recent years, antioxidants have been successfully used in dentistry because of their beneficial effects on human health.
The most important effect is to neutralize the harmful effects of free radicals.

Aim

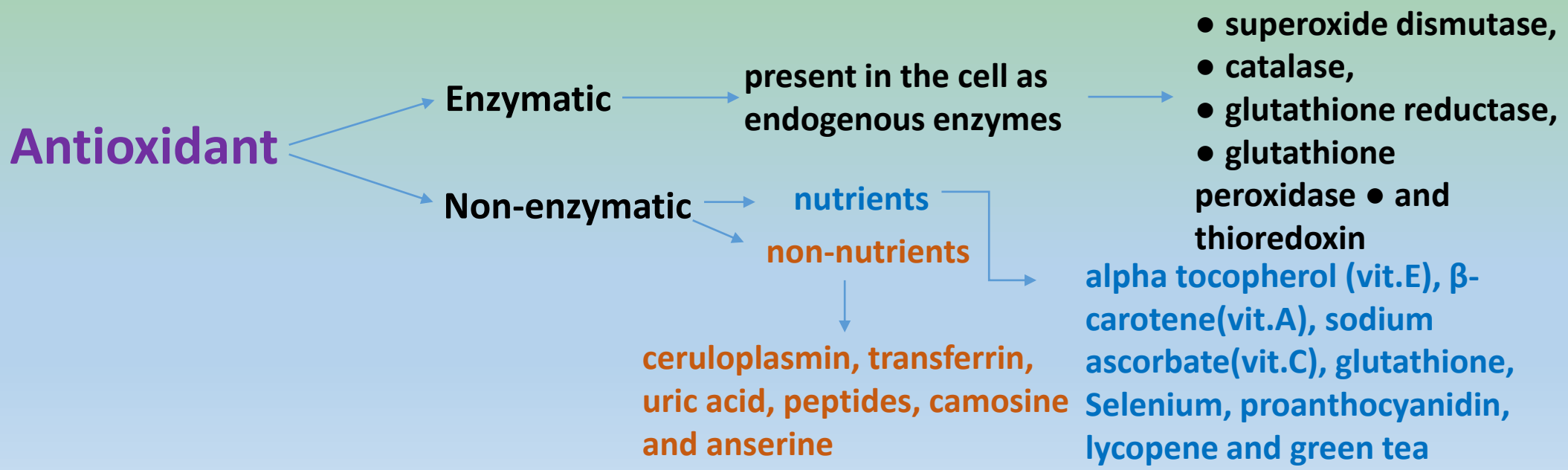
Highlights the use and clinical significance of antioxidant therapy in restorative dentistry

ANTIOXIDANTS

► Molecules that reduce the damaging capacity of free radicals using their scavenging property

► Have the ability to end the electron stealing reaction of free radicals by donating one of their electrons.

►They does not become a free radical by donating an electron because they are stable in either form.

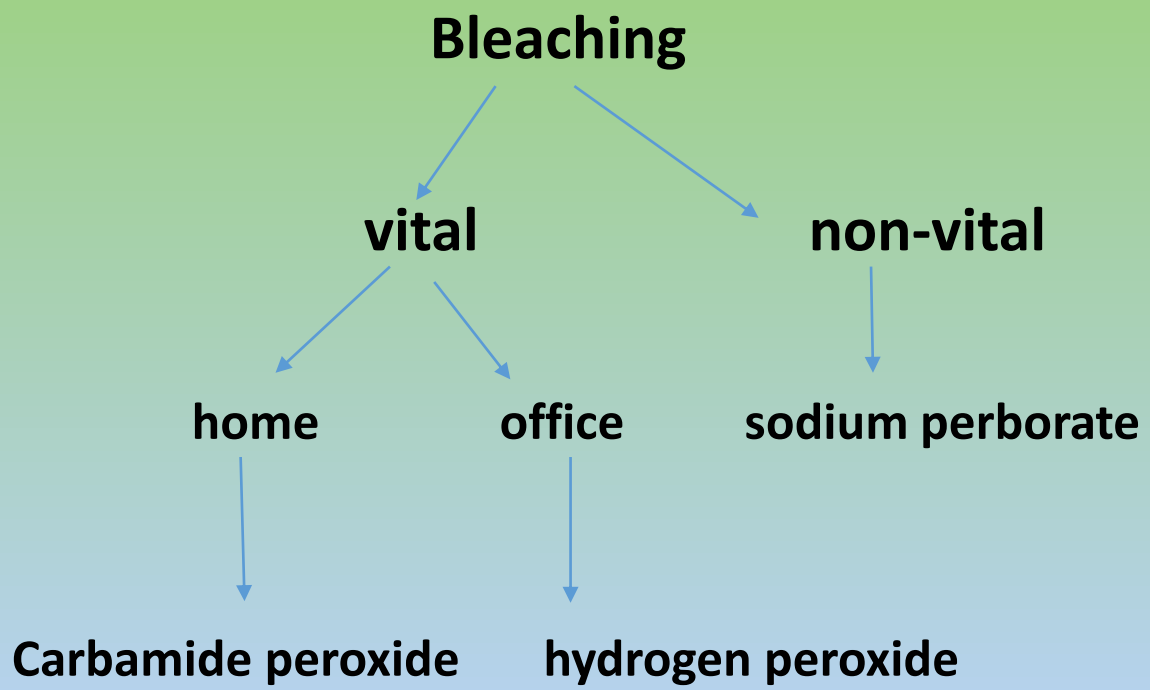


Antioxidant Commonly used in Restorative Dentistry

- Sodium Ascorbate (vitamin C)
- Alpha tocopherol (vitamin E)
- Beta carotene (vitamin A)
- Aloe Vera
- Grape seed extract
- Proanthocyanidin
- pomegranate peel
- Green tea
- Pine Bark
- Guava seed extract

The effects of antioxidants in the treatment methods of restorative dentistry

1. Bond strength after bleaching



(3-40)%

Photochemical reaction (light or laser)

H_2O_2 is an agent that decomposes and creates unstable free radicals, such as perhydroxyl radicals, hydroxyl radicals, superoxide anions, and perhydroxyl anions, when it diffuses into the tooth, thus causing oxidation

Bleaching negatively affect the bond strength of the composite to the tooth structure

Methods proposed to counteract the decreasing bond strength after bleaching

- delayed bonding (wait time, 24 h to 3 weeks)
- grinding away the superficial bleached enamel surface
- the use of acetone-based adhesives
- pre-treatment of the bleached enamel with alcohol.
- the use of antioxidants

1. Bond strength after bleaching

Manoharan et.al, 2016 comparing the effectiveness of 10% sodium ascorbate and 5% proanthocyanidin agents on the bond strength after bleaching , they stated that the use of antioxidants before bonding on bleached surfaces reverses the harmful effect of bleaching agents and increases bond strength

Mukka et al.,2016 found out that the use of antioxidants, especially 5% pine bark extract application after bleaching totally neutralizes the deleterious effects of bleaching on enamel surface and increases the SBS significantly

An in vitro study by ***Gogia etal.,2018*** examined the shear bond strengths of comoposite resins to bleached enamel using 10% sodium ascorbate, 10% alpha tocopherol, 10% grape seed extract, and 10% guava seed extract as antioxidants. The results showed that guava seed extract was the most effective antioxidant increasing the bond strength. With the use of these antioxidants, the bonding strengths of the bleached enamel were effectively increased

Antioxidant pre-treatments are able to reduce waiting time for restorative treatment after dental bleaching: a microtensile bond strength exploratory study

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Abstract

The aim was to evaluate the effect of different antioxidant agents on the improvement of bond strength to enamel subjected to a whitening procedure. Samples were divided into six groups ($n = 10$): control; whitening immediately followed by restorative treatment (WHT); whitening and restoration after a 7-day period (WHT_7D); whitening and application of 10% sodium ascorbate (WHT_SA); application of 5% grape seed extract (WHT_GS); and applicatio
fwere whitened (Opalesce
restored (Optibond™ FL, K
groups these were applie
tioned in microspecimens
testing (0.5 mm/min) on a
correction and Games-Ho
Antioxidant groups preser
($p < 0.001$). The non-white
dant experimental groups
value when compared to
influenced microtensile b

Conclusions

Based on the finding from this study, taking into account limitations related to the in vitro study model, it is possible to infer that the application of conventional and easy preparation antioxidants such as sodium ascorbate, grape seed extract and green tea were all able to immediately increase the bond strength to enamel subject to a dental whitening procedure. Bond strengths after such antioxidant strategies were comparable to non-whitened control and to a 7-day waiting period. This study highlights there may be an advantage in the use of antioxidants by the clinician, decreasing the waiting period until the restorative procedure, eliminating the need for a treatment plan delay, and can serve as a starting point for clinical studies. Furthermore,

2. Microleakage

Effect of Delayed Bonding and Different Antioxidants on Composite Restoration Microleakage of Internally Bleached Teeth

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Abstract

Background: Bleaching the discolored teeth may affect the sealing ability of immediately placed composite resin restoration. The aim of this *in vitro* study was to evaluate and compare the neutralizing effect of delayed bonding and different antioxidant agents on the microleakage of composite restoration in endodontically treated teeth after intracoronal bleaching with hydrogen peroxide.

Materials and methods: Following endodontic therapy, 60 sound human mandibular 2nd premolar teeth of comparable sizes were randomly divided into six groups, each of 10 samples (n=10). Except Group A (negative control), all samples in the other groups were exposed to internal bleaching with 35% hydrogen peroxide (Opalescence® Endo ''walking'' bleach) that placed into the pulp chamber for 5 days. For Group B, the samples were immediately bonded after bleaching. Group C, the bonding procedure was delayed 2 weeks after bleaching. Groups D, E and F, the samples treated with 10% Sodium Ascorbate (SA), 10 % Green Tea (GT) and 10% Pine Bark (PB) respectively and then restored immediately. In all groups, the access cavities were restored using Scotchbond™ Universal Adhesive and Filtek™ Bulk Fill posterior restorative composite resin. Teeth were subjected to 500 thermal cycles and immersed in 2% methylene blue for 1 day. Teeth were sectioned longitudinally from buccal to lingual direction, passing through the center of the restoration, using a diamond disk. The samples were examined under stereomicroscopic magnification (40X). Microleakage was assessed with a 0 – 4 scoring system and analyzed using nonparametric statistical methods (α =0.05).

Results: Internal bleaching with 35 % hydrogen peroxide gel for 5 days resulted in significant ($p > 0.01$) increase in microleakage of composite resin restorations when bonding was performed immediately after bleaching (Group B). No significant difference ($p > 0.05$) was found between negative control group (Group A) and group that bonded after 14 days after bleaching (Group C). Furthermore, there was no significant difference among groups that bonded after treatment with 10% of antioxidant materials (D, E and F) when compared to each other, and when compared to control group (Group A).

Conclusion: The use of antioxidants effectively reversed the compromised sealing ability of composite filling to bleached dental tissue and all the antioxidants used in this study was equally effective to neutralize the adverse effects of hydrogen peroxide on microleakage of immediately

Conclusion

Under the limitation of this *in vitro* study, the following conclusions were obtained:

a) Immediate restoration of bleached enamel and dentine with 35% hydrogen peroxide gel for 5 days, resulting in marked increase in microleakage of composite resin restoration, which performed immediately after bleaching.

b) Delaying the bonding of composite resin to the bleached teeth for 14 days was enough to get rid of the adverse effect of bleaching agent on the microleakage of composite restoration.

c) Treatment of the bleached teeth with 10% sodium ascorbate, 10% green tea and 10% pine bark antioxidant in solution forms for 30 minutes can neutralize the deleterious effect of bleaching material on the microleakage of immediately placed composite restoration.

3. Color stability after bleaching

ORIGINAL ARTICLE

doi: 10.14295/bds.2020.v23i4.2074

Evaluation the Effect of Different Antioxidants Applied After Bleaching on Teeth Color Stability

Material and Methods: This study includes total of 84 extracted intact non-carious lower incisors. 35% hydrogen peroxide was applied on the labial surfaces of specimens in accordance with manufacturer's instructions. The bleached teeth were divided into 7 groups. No antioxidants were applied to the control group. For the experimental groups, the following antioxidants were applied for 10 minutes each: 5% proanthocyanidin, 5% sodium ascorbate, 5% lycopene, %5 green tea, %5 white tea and %5 ?-tocopherol. CIE L*, a* and b* values of the teeth were measured by a spectrophotometer. The data were analyzed using IBM SPSS version 23.

CONCLUSION

Proanthocyanidin, sodium ascorbate, green tea and white tea are reliable post-bleaching antioxidants for maintaining color stability. The application of lycopene

4 . Remineralization

“The process whereby calcium and phosphate ions are supplied from a source external to the tooth to promote ion deposition into crystal voids in demineralized enamel to produce net mineral gain.”

Silva et al. 2015 compared the remineralization effect of grape seed extract and fluoride under cariogenic challenge on enamel and dentin. The samples that were treated with grape seed extract and fluoride showed statistically higher remineralization than the untreated groups.

According to a study in 2017, researchers used two antioxidants after bleaching and observed their effects on enamel structure and hydroxyapatite crystal growth. In the study, catalase and sodium ascorbate were used as antioxidants, and the test groups were examined after 72 h. The results showed that using antioxidant after bleaching can increase the remineralization capability of saliva, but the topographical properties do not reverse to the initial form.

5- Dentin hypersensitivity

Dentin hypersensitivity is a short and sharp pain arising from exposed dentin in response to a thermal, evaporative, tactile, osmotic, or chemical stimulus and cannot be associated with any other form of dental pathology or defect

The **treatment modalities of hypersensitivity** include occluding the dentinal tubules or impeding or diminishing neural transmission

Desensitizing agents, such as potassium, fluoride, hydroxyapatite, copal varnishes, and Ca(OH)2 , or dentin bonding agents

Propolis, a bee product, has been a striking natural agent for the treatment of dentin hypersensitivity

Sankari et al. in 2014 stated that propolis occludes dentinal tubules and reduces dentinal hypersensitivity of periodontally involved teeth.

Purra et al. in 2014 compared the desensitizing effect of propolis with 5% potassium nitrate and distilled water. Their results showed that propolis is the most effective desensitizing agent in the intermediate relief of sensitivity.

Pulp capping

When dental pulp is exposed either traumatically or because of caries, direct pulp capping technique is used for protecting pulpal health and function, allowing the patients to retain their teeth longer and at lower costs than root canal treatment, which is an alternative invasive technique

Melatonin

Is a hormone synthesized and secreted by the pineal gland and other organs.

Melatonin was proven to directly neutralise ROS acting as an antioxidant in several conditions and tissues.
Due to its antioxidant properties and its ability to detoxify free radicals, melatonin can also interfere in the bone resorption process, mediated by the osteoclasts acting at the level of the osteoclast lacuna and blocking the reactive oxygen species produced by the superoxide dismutase

-***Gironés et. Al, 2020*** hypothesized that melatonin's mechanism of action on teeth and odontoblasts might be the same as its action on osteoblasts in the bone. The proven anti-inflammatory action of melatonin encouraged its employment as a pulp-capping agent .

The local action of melatonin on dental pulp had similar effects to those of MTA, suggesting that it may be an alternative drug for performing direct pulp capping

Propolis

Is a natural biocompatible material that has been widely studied in dentistry because of its anti inflammatory, anti-microbial and immunomodulatory properties. One of the active components is caffeic acid phenethyl ester (CAPE). CAPE is effective in stimulating collagen as well as inhibiting the inflammation and degeneration of dental pulp.

Ahangari et al. in 2012 investigated the effect of propolis as an alternative material to Ca(OH)2 on dentin regeneration and on the potential role of dental pulp stem cells. They reported that although more stem cells were found in the Ca(OH)2 control group at each time point,

The propolis group showed superior properties over Ca(OH)2 with respect to the prevention of the formation of inflammation, infection, and necrosis and inducing the formation of higher quality tubular dentin.

Additionally, the elements of propolis, such as iron and zinc, are effective in the synthesis of collagen, and flavonoids regulate the immune system response.

Parolia et al.in 2010 reported that the response of dental pulps to propolis as a pulp capping agent is comparable to that of ProRoot MTA , propolis delays pulpal inflammation and stimulates reparative dentin formation.

CONCLUSION

The use of antioxidants can open a new possible treatment modality for restorative procedures to prevent the negative effects of ROS.


THANK
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