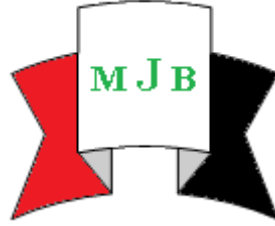


An Overview on the Effects of 10% and 15% Carbamide Peroxide and its Relationship to Dentine Sensitivity

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Abstract

Tooth bleaching or whitening is not a new technique in dentistry and it is evident from the published literature that the technique has been in use for over one hundred and fifty years . The question concerning the whiteness of teeth is a complex one since tooth whiteness may vary from individual to individual, and is also dependent on the age of the individual and culture etc. Tooth whitening following treatment may also be dependent on the type of whitening system used to whiten the teeth. There are a number of side-effects to this process and these include dentine sensitivity and gingival irritation . Normally these side effects should resolve after approximately 48 hours following treatment although in extreme situations may last for several months. The purpose of this overview was therefore to review the available published literature in order to determine whether there was any evidence that the application of 10% and 15% carbamide peroxide in tooth whitening procedures resulted in tooth (dentine) sensitivity. The conclusions from the review would indicate that tooth whitening with either 10% or 15% carbamide peroxide was an effective and safe treatment under a dental professionals' supervision following careful diagnosis and treatment planning. Reported side-effects from these studies, namely dentine sensitivity and gingival irritation were considered mild to moderate in nature and were transient in duration. Reported incidences of dentine sensitivity range from 15-65% of patients using 10% carbamide peroxide whereas higher incidences (67-78%) were reported when using hydrogen peroxide in combination with heat .

Key Words: Bleaching, Carbamide Peroxide, Tooth Sensitivity, Prevalence,

الخلاصة

قصر او تبييض الاسنان ليست تقنية جديدة في مجال طب الاسنان ويتضح من البحوث المنشورة ان هذه التقنية قد تم استخدامها لكثر من مائة وخمسين عاما بياض الاسنان عملية معقدة بسبب ان بياض الاسنان قد يختلف من شخص الى آخر ، ويعتمد ايضا على العمر والثقافة .. الخ تبييض الاسنان بعد العلاج ربما يعتمد على نوع نظام التبييض المستخدم لتبييض الاسنان . هناك عدد من الآثار الجانبية لهذه العملية ، منها حساسية الاسنان وتهيج اللثة هذه الآثار الجانبية ينبغي ان تزول عادة بعد حوالي ٤٨ ساعة بعد العلاج رغم انه في الحالات الحادة قد تستمر لعدة اشهر . الغرض من هذا الاستعراض هو تحديد ما اذا كان هناك دليل على ان استخدام ١٠% و ١٥% من بيروكسيد كاراميد في عملية تبييض الاسنان تسبب في حساسية طبقة العاج في الاسنان . ان الاستنتاجات من هذا الاستعراض تشير الى ان تبييض الاسنان باستخدام ١٠% او ١٥% من بيروكسيد كاراميد هو علاج فعال وآمن باشراف اطباء الاسنان بعد التشخيص الدقيق والتخطيط للعلاج . الآثار الجانبية التي تم ملاحظتها من هذه الدراسات ، هي حساسية طبقة العاج وتهيج اللثة والتي تعد في طبيعتها خفيفة الى معتدلة وتكون قصيرة الفترة . تم ملاحظة حالات من حساسية طبقة العاج تراوحت نسبتها بين ١٥ - ٦٥% من المرضى الذين استخدموا ١٠% من بيروكسيد اليوريا بينما حالات بنسبة اعلى (٦٧ - ٧٨%) عند استخدام بيروكسيد الهيدروجين يرافقه حرارة .

Introduction

According to Joiner [1] the aesthetics or appearance (including tooth colour) of teeth is of great importance to patients. It has been reported that in the UK 28% of adults are dissatisfied with the appearance of their teeth [2] whereas in the USA 34% of an adult population were dissatisfied with the colour of their teeth [3].

Currently four altered approaches to vital tooth whitening have been suggested [8, 11] and these are:

- 1) The use of an elevated concentration of hydrogen peroxide or carbamide peroxide (Dentist-administered bleaching),
- 2) The use of a bleaching tray with an elevated concentrations of hydrogen or carbamide peroxide (In-Office Dentist-supervised bleaching),
- 3) At home or night guard bleaching: available in the form of a custom-made tray with a solution of carbamide peroxide at a lower percentage of active ingredients (Dentist-provided bleaching/ patient administered)
- 4) Various concentrations of hydrogen peroxide or carbamide peroxide products available in pre-fabricated trays or whitening strips (Over-the-Counter (OTC) products available for administration by patients/consumers). (Table 1)

Tooth whitening procedures:

Tooth whitening can include professionally dispensed products and over-the-counter (OTC), patient-purchased products. Procedures for tooth whitening may include whitening tooth pastes, OTC bleaching products, routine dental prophylaxis, professionally dispensed vital bleaching products, non-vital tooth bleaching, and even denture cleaners. Bleaching may also be used as a treatment for teeth that become

discoloured due to intrinsic or extrinsic staining.

Professionally dispensed vital tooth bleaching refers to the materials, techniques, and devices used for vital bleaching that are dispensed in the dental office. In recent years, patients have had an increased interest in bleaching to treat discoloured teeth. Bleaching, especially at-home bleaching interests' patient and dentists alike because it is the most conservative, non invasive treatment modality currently available to the dental clinician to change the appearance of the teeth. Bleaching is used to light the shade of the teeth that are darkening due to intrinsic and extrinsic discoloration. These techniques can include a variety of concentrations of hydrogen and carbamide peroxide, in-office techniques with or without heat or light enhancement, professionally dispensed whitening strips, and tray bleaching [12]

There are however a number of related adverse effects following tooth whitening procedures that have been reported (Table 2)

1- Cervical root resorption

Is an inflammatory-mediated external resorption of the root, which can be seen after trauma and following intracanal bleaching [8, 13].

2- Tooth sensitivity

Tooth (dentine) sensitivity is a common side-effect of external tooth bleaching [14]. Tooth (dentine) sensitivity normally persists for up to 4 days after the cessation of bleaching treatment [15, 16] but a longer duration of up to 39 days has been reported [4, 17]. Patients with a previous history of tooth (dentine) sensitivity may thus have a higher risk for such an adverse effect from external tooth bleaching, and this should be taken into account before treatment begins [8]. (See Table 2).

3- Mucosal irritation:

A high concentration of hydrogen peroxide is caustic to mucous membrane and may cause burns and necrosis of the gingival [8].

4- Alteration of the enamel surface:

Morphological alteration of the enamel following tooth bleaching has been addressed in several studies [8].

5- General side effects:

Studies have shown that hydrogen peroxide is an irritant and also cytotoxic in nature [2], for example It is known that at concentrations of 10% hydrogen peroxide or higher, the chemical is potentially corrosive to mucous membranes and causing a burning sensation and tissue damage [18, 19]. During office bleaching treatment, which routinely uses a high concentration of hydrogen peroxide, severe mucosal damage may occur if gingival protection is inadequate [2]. Clinical studies have also reported a higher prevalence of gingival index in patients using bleaching material of higher peroxide concentrations [20, 21].

In vitro studies suggest that dental restorative materials may be also affected by tooth bleaching agents [22]. These findings relate to possible physical and/or chemical changes in the materials, such as increased surface roughness, crack development, marginal breakdown, release of metallic ions, and decreases in tooth-to-restoration bond strength [9].

Tooth whitening systems:

Tooth whitening with various concentrations of hydrogen and carbamide peroxide has been verified to be harmless and useful in a different of regimen, Take home system, Light activated whitening systems, and home treatments with dentist prescriptions and supervision. (Table 3)

Mechanism of action of tooth whitening:

There is no clear-cut of how this system works to lighten the tooth colour. Hydrogen peroxide diffuses through the organic matrix of the enamel and dentine [23, 24]. Since the radicals have unpaired electrons, they are extremely electrophilic and unstable and will attack most other organic molecules to achieve stability, generating other radicals. These radicals can react with most unsaturated bonds, resulting in disruption of electron conjunction and a change in the absorption energy of the organic molecules in tooth enamel. Simple molecules that reflect less light are formed, creating a successful whitening action. This process occurs when the oxidizing agent (hydrogen peroxide) reacts with organic material in the spaces between the inorganic salts in tooth enamel [25]. The reported soft-tissue irritation was mild and transient as a common side effect of peroxide-based whitening procedures [26] and with the close professional control in the application and protection of surrounding tissues tooth-whitening procedures reduced gingival irritation [5].

As indicated above Hydrogen peroxide is very unstable and it foams and fizzes as soon as it contacts any organic material. The original at-home bleaching products used a 10% solution of carbamide peroxide as the bleaching agent, which are basically 3% hydrogen peroxide and 7% urea. The urea in carbamide peroxide primarily acts as stabilizer to give these products a longer shelf life, slower release of the hydrogen peroxide, and reported additional cariostatic benefits. It has been suggested that hydrogen peroxide penetrates the tooth more quickly than carbamide peroxide. The basic mechanism of action is the same, but

the formulation effects shelf life and time required for penetration of the teeth [27].

Bleaching related sensitivity and pain: Possible mechanism of action:-

A sensation of tooth-pain results from virtually all forms of stimuli, both natural and electrical, that activates these afferents.

A number of theories have been proposed in order to understand the mechanism identifying the transmission of stimuli across the dentine surface.

- 1- Odontoblast-receptor theory
- 2- Direct nerve endings theory
- 3- Hydrodynamic theory

The hydrodynamic theory of stimulus transmission across dentine as described by Brännström [28] proposed that minute rapid shifts of the fluid within the dentine tubules (following stimulus application e.g., cold air blast) may result in activation of the sensory nerves in the pulp/inner dentine region and this in turn gives rise to a perception of pain in the patient. According to Gillam [29] it is evident that according to this theory that the tubule acts as a capillary bore and as such the tubule diameter has a critical effect on the rate of flow of fluid within the tubule and hence the ability to stimulate the sensory nerve fibres in the pulp.

The hydrodynamic theory of dentine sensitivity is currently accepted as the mechanism of dentinal sensation, and as such many authors appear to accept bleaching related pain as a form of dentine sensitivity [30, 31].

Although pain in bleached teeth can be evoked by thermal or other stimuli, most patients complain of twinge, shock like [32], tingling or shooting pain 'zingers' [33] without provoking stimuli. This pain may continue for a period of time following the actual bleaching treatment.

It has been suggested that pain experienced during the bleaching can affect intact teeth lacking dentine exposure; this is in sharp contrast to dentine sensitivity where pain occurs in teeth with exposed dentine. Teeth with defects such as: caries, defective restorations [34], or exposed dentine has been suspected of being more prone to bleaching sensitivity than intact teeth. These defects may therefore provide a direct diffusion pathway for peroxide to the deep dentine.

It has been suggested that oxygen bubbles form in the dentinal tubules during peroxide application and that these small pockets of gas may cause dentinal fluid movements that activate the intradental nerves [35]. No evidence however has been advanced to support this interesting hypothesis. Many bleaching products are glycerine-based anhydrous gels that exert a high osmotic force on the tooth tissue. If fluid movements resulting from dentine desiccation caused bleaching sensitivity, bleaching sensitivity would therefore could be a form of hydrodynamically mediated pain. Studies demonstrating mild sensitivity in some patients using placebo bleaching-gels that lack peroxide may support this view [5], even though the pain intensity in placebo-gel treated patients was lower than in peroxide-exposed subjects [36]. The presence of an anhydrous vehicle is not a necessary factor in bleaching sensitivity since sensitivity is a common side effect of treatment with bleaching systems that use glycerine-free peroxide solutions [33]. In summary, despite its strong support as the mechanism underlying the generation of most forms of dentine sensitivity pain; the hydrodynamic hypothesis does not appear to fully explain the mechanism of pain in bleaching sensitivity.

Bleaching sensitivity during tooth whitening:

Several investigators have advocated the use of desensitizing products when considering bleaching or whitening teeth [37-39]. For example the use of a product containing 5% Potassium nitrate or fluoride in a tray prior to, during and following treatment may be beneficial in reducing bleaching sensitivity [38]. Amorphous calcium phosphate (ACP) can also be used either as a toothpaste or as a professionally applied product [40]. For patients with pre-existing dentine sensitivity the use of a desensitizing product (toothpaste or in a bleaching tray) prior to bleaching the teeth may alleviate further discomfort during the bleaching phase of the treatment [8, 37, 41]. The efficacy of desensitizing agents used in patients who experience dentine sensitivity during tooth whitening has been reported in a study of such patients [39]. According to Haywood [42] and Tredwin *et al.* [43] sensitivity is a common adverse reaction of external bleaching.

Efficacy of the products used to treat dentine sensitivity in bleaching:

There are two main categories of desensitizing product action:

- 1- Occlusion of dentinal tubules: By occluding (plugging) the dentinal tubules movement of intratubular fluid is either reduced or prevented and sensitivity is subsequently minimised or prevented [5, 29, 44-45].
- 2- Neuronal suppression: Chemical effects on pulpal neurons reducing the ability of pulpal neurons to fire (application of Potassium (K⁺) ions to desensitize nerve endings in the pulp) [29].

Fluoride: Stannous and sodium fluoride have been reported to combine with salivary calcium to create a precipitation of insoluble calcium fluoride within the dentinal tubules

[37] the process of tubular occlusion with fluoride applications may require repeated applications over time and the resultant deposit may therefore not necessarily occlude the tubules or reduce dentine sensitivity effectively.

Amorphous Calcium Phosphate (ACP): ACP was used initially for the remineralization of enamel, not dentine. The growth of inorganic hydroxyapatite deposit within the highly organic matrix of dentine is highly questionable [50-52]. Even if ACP were to actually promote mineralized formation within dentinal tubules, this process would not be necessarily immediate in nature. The action of ACP on enamel is more of a growth of hydroxyapatite deposition instead of a rapid occlusion of tubules [34]. The use of ACP has however not met with wide-spread reports of desensitizing success with bleaching [38-40].

Potassium Nitrate: does not appear to act by occluding dentinal tubules and as such does not reduce tubular flow [29]. It is proposed that it may reduce nerve excitability (inhibit repolarization of pulpal neurons [6, 29,45], however the clinical efficacy of K⁺ ions in potassium containing toothpastes does not appear to be strongly supported in the literature [29, 45]. It has been hypothesized that in order for K⁺ ions to achieve its effect it must first diffuse through the dentinal tubules into the pulp [45].

It is apparent from earlier studies by Pashley [46] that one could not demonstrate the mode of action of Potassium in the *in vitro* model; however the desensitizing effect was however subsequently demonstrated in an animal model [29, 45, 47-48]. From a clinical perspective it is more likely that other ingredients in the toothpaste, for example silica may block the dentinal tubules as demonstrated in the disk model [49]. Furthermore, a product

containing 5% Potassium nitrate and 0.454 percent Stannous fluoride in a silica base, demonstrated to have a significantly greater reduction in dentine sensitivity in a clinical study, was also demonstrated to have the lowest hydraulic conductance (permeability) and greatest inward K^+ flux in the dentine disks model [49-51]. There is no doubt however that toothpastes containing 5% Potassium nitrate with other additives may be effective in reducing dentine sensitivity [45, 51-58]. For best results, patients should use desensitizing toothpaste twice a day as part of their oral care regimen. It may take 7 to 14 days for the patient to notice an appreciable decrease in sensitivity, patients should be advised to see their dentists if symptoms persist longer than 4 weeks.

A number of desensitizing toothpastes using 5% Potassium nitrate will also contain fluoride for an anti-carries effect, as well as an anti-tartar, anti gingivitis, and/or whitening ingredients (e.g., Sensodyne®) in order that multiple claims by the manufacturers to be made for treatment for a given toothpaste.

Haywood and colleagues [37] also reported that using Potassium nitrate-fluoride gel applied in the bleaching tray in patients with dentine sensitivity reduced the sensitivity in the majority of the patients and produced some degree of pain relief. However, it is worth mentioning that this study did not include a placebo group. A further study [39] reported that the use of an active 3% Potassium nitrate and 0.11 % fluoride desensitizing agent for 30 minutes prior to whitening decreased dentine sensitivity compared to a placebo control.

Strontium chloride: (10%) was the first tubule blocking ingredient to be introduced into toothpaste, approximately 50 year ago (59). It was

largely replaced by Potassium nitrate in the United States of America from the 1970s, because Strontium was perceived to have failed as “a superior desensitizer” [59]. Over the subsequent 20 years or so, two substantive changes have been made to strontium-based toothpastes: one was to replace the original abrasive, diatomous earth, with silica; the other was to add fluoride and replace the original strontium chloride with strontium acetate (8%), which would enable fluoride to be incorporated into the toothpaste.

In 1994, Zappa [60] summarized the results of early clinical studies on Strontium chloride toothpaste and stated “in summary, that self applied 10% Strontium chloride hexahydrate desensitizing toothpaste seems to be effective in relieving the pain of dentine sensitivity. Jackson [61] in a review concluded that significant improvements in patients’ symptoms of dentine sensitivity were observed for strontium-based products compared with the negative control toothpaste in selected clinical studies. However, Cummings [62] in a recent review questioned the efficacy of strontium – based toothpastes for the treatment of dentine sensitivity.

Materials and Methods

The following search strategy was employed namely a comprehensive search to identify all relevant studies, until 31st December 2012. Relevant studies were identified by searching two major electronic databases from date of inception: Ovid MEDLINE and PUBMED. Hand searching of reference list of articles and reviews was also carried out. This review was carried out in Barts and The London School of Medicine and Dentistry, London, UK.

Discussion and Conclusions

Tooth whitening using different concentrations up to 15% carbamide peroxide has been considered to be an effective and safe treatment under a dental professionals' supervision following careful diagnosis and treatment planning. The reported side effects namely dentine sensitivity and gingival irritation are generally mild to moderate in nature and in the majority of reported studies is a transient problem. It is however important for the supervising dental professional to monitor the patient undergoing dentine bleaching procedures and intervene if necessary in a situation where dentine sensitivity may affect the patient quality of life. Treatment of dentine sensitivity would be subsequently based on the severity of the complaint and may involve the provision of a desensitizing tooth paste, gel or varnish or sealant. Tooth whitening procedures using carbamide peroxide solutions/gels greater than 10% may be associated with increases in dentine sensitivity. Patients should therefore be informed that they may experience some mild transient dentine sensitivity or gingival irritation when undergoing tooth whitening procedures.

It has also been reported that patients who have a pre-existing history of dentine sensitivity or with recession and associated dentine sensitivity may be more likely to experience dentine sensitivity during the bleaching process [5].

Although there is widely held belief that higher concentration of bleaching agents produce a greater prevalence of dentine sensitivity, studies reported in the published literature appear to disprove this perception [33].

Several investigators have advocated the use of desensitizing products when considering bleaching

or whitening teeth [37-39]. For example the use of a product containing 5% Potassium nitrate or fluoride in a tray prior to, during and following treatment may be beneficial in reducing bleaching sensitivity [38]. Amorphous calcium phosphate (ACP) can also be used either as a toothpaste or as a professionally applied product [40]. For patients with pre-existing dentine sensitivity the use of a desensitizing product (toothpaste or in a bleaching tray) prior to bleaching the teeth may alleviate further discomfort during the bleaching phase of the treatment [8, 37, 41]. The efficacy of desensitizing agents used in patients who experience dentine sensitivity during tooth whitening has been reported in a study of such patients who had pre-existing symptoms prior to the start of the whitening procedure [39].

Bleaching sensitivity is believed not to be related to exposed root surface or dentine or caries, but rather can be explained by the easy passage of the hydrogen peroxide molecules through the enamel and dentine into the pulp [63-64]. This results in pulpal inflammation affecting the pulpal sensory nerves that are initiated in response to stimuli, such as cold drinks, until the inflammation subsides. From clinical experience, however, dentine exposure may be a factor in dentine sensitivity as it is often misdiagnosed as not being present clinically. Furthermore, other workers [5] have correlated the incidence and severity of thermal sensitivity with gingival recession and the frequency, not actual duration, of the treatment [33, 39].

Risk factors for the development of bleaching sensitivity and gingival irritation that are associated with night guard vital bleaching have been (35%) reported by Leonard *et al.* [10]. No statistical

relationship, however, existed between age, gender or tooth characteristics, with the dental arch bleached and the development of side effects. However there was a statistically significant association existing between the side effects and the whitening solution used. This association however disappeared when the analysis was controlled for usage pattern. Patients who changed the whitening solution more than once a day reported more statistically significant side effects than did those who did not change the whitening solution during their usage time.

Cohen and Chase [16] also attempted to relate the prevalence of dentine sensitivity in vital bleaching using high concentration of hydrogen peroxide and heat in 30-min sessions with possible histological pulpal changes. Histological findings from the study showed that pulps were normal except for moderate vasodilatation and aspiration of odontoblast nuclei into the dentinal tubules. They concluded that sensitivity and discomfort during and after bleaching procedures were caused by heat application increasing the intrapulpal pressure that leads to the sensation of pain. Histological changes to the pulp after night guard vital bleaching with 10% carbamide peroxide have recently been reported to be minor; they did not affect the overall health of the pulp tissue and were reversible within 2 weeks post-treatment [64].

In a clinical study monitoring post-operative discomfort associated with vital bleaching, Nathanson [65] reported that 30% of patients had no sensitivity, whereas the majority of the others only experienced mild symptoms lasting less than 24 hours, with patient age having no effect on the degree of sensitivity experienced. This was contrary to the widely held view that younger patients with wider

pulp horns would develop more sensitivity.

There is evidence that whitening products work when compared with placebo/no treatment. There are differences in efficacy between products, mainly due to the levels of active ingredients, hydrogen peroxide and carbamide peroxide. All studies were however short term in duration and the majority of the studies were judged to be at high risk of bias and were either sponsored or conducted by the manufacturers. There is a need for pragmatic long-term and independent clinical studies that include participants representing diverse populations. There is a need however to evaluate long-term outcomes [66].

In conclusion, available data from the published literature would suggest that extra coronal bleaching treatment in the dental office or at home may cause short-term dentine sensitivity and/or gingival irritation. More severe mucosal damage is also possible with high hydrogen peroxide concentrations greater than 10-15% [9]. While available evidence supports the safety of using bleaching materials of 10% carbamide peroxide (3.5% hydrogen peroxide) by dental professionals, there are concerns with the use of at-home bleaching materials with high hydrogen peroxide concentrations. Studies designed specifically to assess the long-term safety of high hydrogen peroxide concentration in at-home bleaching materials are needed, especially for repeated use of these products. There appears to be insufficient evidence to support unsupervised use of peroxide-based bleaching materials [9]. Furthermore most of the earlier published studies on 10% and 15% carbamide peroxide application failed to record whether subjects had any pre

existing sensitivity prior to the commencement of study.

Further research therefore is required using recommended methodology for evaluating dentine sensitivity [9, 67] in order to determine the true extent in terms of prevalence or incidence of dentine sensitivity during the tooth whitening process and to determine the effectiveness of desensitizers in preventing or reducing dentine sensitivity.

For patients with pre-existing dentine sensitivity the use of a desensitizing product (toothpaste or in a bleaching tray) prior to bleaching the teeth may alleviate further discomfort during the bleaching phase of the treatment [8, 37, 41]. The efficacy of desensitizing agents used in patients who experience dentine sensitivity during tooth whitening has been reported in a study of such patients who had pre-existing symptoms prior to the start of the whitening procedure [39].

A number of studies have assessed the occurrence of the sensitivity relative to its time of onset and duration of the symptoms. The incidence of sensitivity ranged from 15 to 65% of patients using 10% carbamide peroxide [8,4], and the average first report of sensitivity was after 4.8 days, usually lasting for 5 days [14, 33]. It has been reported that two-thirds of patients generally experience sensitivity during home bleaching, which usually lasts between 1 and 4 days [15, 68-69]. The conclusions from the review would indicate that tooth whitening with either 10% or 15% carbamide peroxide was an effective and safe treatment under a dental professionals' supervision following careful diagnosis and treatment planning [5]. Reported side-effects from these studies, namely dentine sensitivity and gingival

irritation were considered mild to moderate in nature and were transient in duration. Reported incidences of dentine sensitivity range from 15-65% of patients using 10% carbamide peroxide whereas higher incidences (67-78%) were reported when using hydrogen peroxide in combination with heat [6-7].

Patients who have a pre-existing history of tooth sensitivity or with recession and associated tooth sensitivity may be more likely to experience tooth sensitivity during the bleaching process and as such relevant treatment in form of the provision of desensitising products to alleviate any associated pain arising from dentine sensitivity should be implemented [5].

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Table 1 Different approaches to vital tooth whitening

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| <ol style="list-style-type: none"> 1- Dentist- administered bleaching. 2- In-Office Dentist-supervised bleaching. 3- Dentist-provided bleaching/ patient administered. 4- Over-the- Counter (OTC) products available for administration by patients/consumers. |
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Table 2 Adverse effects following tooth whitening procedures:

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| <ol style="list-style-type: none"> 1- Cervical root resorption 2- Tooth (dentine) sensitivity 3- Mucosal irritation 4- Alteration of enamel surface 5- General side effects Why have you include this |
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Table 3 Tooth whitening systems

- 1- Take home system
- 2- In-office system including power bleaching
- 3- Combination techniques including night guard vital bleaching
- 4- Whitening strips
- 5- Light activated whitening systems
- 6- Tooth paste
- 7- Over the counter products