Evaluation of the most frequent dental dyscromia and clinical protocol for Home Bleaching Technique

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Corresponding Author:
Dr. Andrea Quaranta,
Dentist, Dipartimento di Scienze Odontostomatologiche e Maxillo Facciali, Universita’ degli Studi di Roma - Italy

Submitting Author:
Dr. Francesca Muggiano,
Dentist, Dipartimento di Scienze Odontostomatologiche e Maxillo Facciali, Universita’ degli Studi di Roma - Italy

Other Authors:
Dr. Ivana Giannantoni,
Dentist, Dipartimento di Scienze Odontostomatologiche e Maxillo Facciali, Universita’ degli Studi di Roma - Italy
Dr. Michele Previati,
Dentist, Azienta Sanitaria Regione Molise, Campobasso - Italy

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Evaluation of the most frequent dental dyschromia and clinical protocol for Home Bleaching Technique

Author(s): Muggiano F, Quaranta A, Giannantoni I, Previati M

Abstract

Dental Whitening is the term used to concern dental procedures order to change the color of teeth. Whitening aesthetic procedures are very useful to resolve dental chromatic aberrations caused by systemic diseases, pathological conditions of the oral cavity, traumatic events, use of different drugs or medicaments, assimilation of chemicals and particular foods.

Usually, all whitening procedures are performed in the dental office by dentists or dental hygienists. However not outpatient whitening procedures do exist, those are initiated in the dental office and completed, at home, by the patient.

This technique is called Home Bleaching: it includes the realization of two individual transparent vacuum formed templates where a whitening agent is applied inside. The templates are applied in contact with vestibular and incisal tooth surface and are kept for a period of time based on the severity of discoloration and on the concentration of the bleaching agent used for the treatment.

Introduction

The mouth, teeth and perioral tissues, not only participate in the masticatory, respiratory and phontatory function but they are also responsible for communicative functions. Nowadays, shining white smile helps to improve and make more pleasing the overall appearance of a person and his relationship and perception toward himself and others. The smile is a strong communicative element and has a great impact on social interrelationship, it’s like a business card that contributes to the first impression that others have of us. Several statistical surveys have shown that many people are getting tired of having yellow stained teeth and, indeed, among the people began to spread the idea that even the color of natural teeth, which is individual and genetically determined, is darker to the color than they would like. For this reason, more and more people, both young and older, have chosen to undergo teeth whitening procedures. People aims to have always whiter teeth undergoing whitening treatments to further enhance their smile.

Materials and methods

The variables that determine the color of teeth are: genetic factors, dietary factors, local and systemic factors, medications and traumatic events. Teeth discolorations can be divided in two types: extrinsic dyschromia (due to localized pigmentation on the external tooth surfaces) and intrinsic dyschromia (due to chromogenic substances present at the level of internal tooth structure).

Table 1: Major extrinsic and intrinsic discolorations.

The extrinsic discolorations caused by bacterial aggregates, smoking, food and chemical or metal substances.

The extrinsic discoloration of bacterial origin are different:

1. White- yellow pigmentations are due to plaque and supragingival calculus that are deposited all over dental surfaces but especially nearby salivary glands' outlet. It is generally associated with poor oral hygiene.
2. Green pigmentations recognize an etiology similar to the previous but are predominantly located on the labial surfaces of frontal teeth or where the enamel is more rough.
3. Orange pigmentations are rare and affects mainly children with poor oral hygiene exclusively on cervical areas of frontal teeth.
4. Brown pigmentations are due to specific bacterial aggregates (Actinomycetes) that produce iron sulfide and appear as thin bands near the gingival margins.

Extrinsic discolorations from smoking are brown - black and located all over tooth surfaces with greater accumulation in rough areas, pits and fissures. Cigarette smokers concentrate pigments on lingual surfaces. Discolorations from tobacco can penetrate the enamel prisms becoming intrinsic.

Food and beverages (coffee, tea, spices etc.) produce brown - black discolorations very similar to those
caused by smoking nearby rough surfaces, pits and fissures.

Some chemicals such as stannous fluoride and chlorhexidine (anti-bacterial) pigment tooth surfaces but especially in the interproximal areas. Even some metals contained in medicines or present in the workplace environment can be deposited on and discolor teeth. For example, a brown pigment is determined by iron and cadmium, a blue-green discoloration due to copper, brass and nickel pigmentation.

Intrinsic discolorations differ according to their pathological onset: post-eruptive and pre-eruptive intrinsic discoloration.

Post-eruptive intrinsic discolorations are due to necrotic teeth, endodontic materials, tooth decay and fillings.

1. A tooth becomes non-vital as a result of hemorrhage or necrosis of the pulp. These events are caused by pulp inflammation or trauma that trigger the inner release and storage of substances such as hemoglobin. The degeneration of hemoglobin degrades the iron in ferrous sulfide, giving at first a pink then gray and finally brown tooth color.

2. The permanence of endodontic cements (endometasone), root canal medicaments (iodoform paste) or gutta-percha produce different tooth color.

3. Tooth decay has bacterial origin and produces brown and black spots.

4. Filling materials such as silver amalgam release metal salts inside the oral cavity that discolor the tooth producing pigmentation color tending to black.

Pre-eruptive intrinsic discolorations are caused by dentinogenesis imperfecta, amelogenesis imperfecta, fluorosis, enamel hypoplasia, tetracycline intake, trauma (Turner's tooth), systemic diseases.

1. Dentinogenesis imperfecta is an autosomal dominant hereditary anomaly that affects dentinal-pulp complex; teeth color varies from blue to brown.

2. Amelogenesis imperfecta is an inherited autosomal abnormality linked to the X chromosome and causes abnormalities of structure which determines yellow and brown discolorations.

3. Fluorosis is due to a chronic fluoride intoxication that causes an ameloblastic function alteration producing localized or diffuse spots ranging from milky white to brown.

4. Enamel hypoplasia is due to a disorder of enamel matrix mineralization, and determines the presence of whilish spots.

5. Discoloration induced by tetracycline is an enamel discoloration caused by the administration to women in the last month of pregnancy or to the child during the period of tooth development (until 8 years old) of these category of drugs. Tetracycline binds to calcium forming a calcium-tetracycline complex that determines yellow-brown pigmentation.

6. Turner's tooth is an enamel hypoplasia due to a follicular intrusive trauma on the deciduous that interacts with the development of the permanent tooth below. It is associated to yellowish-white spots.

7. Systemic diseases that produce intrinsic discolorations are numerous. Those most frequently encountered are:

(i) Phenylketonuria that causes brown or black pigmentation due to metabolism alteration of phenylalanine;

(ii) Congenital erythropoietic porphyria that is a blood disorder causing reddish brown teeth;

(iii) Erythroblastosis fetalis that is a hemolytic disease due to the passage of maternal antibodies through the placenta against the fetal red blood cells. The disease produces dental yellow-green stains: thus is cause by bilirubin, a breakdown product of hemoglobin.

All these types of discoloration are gathered on the basis of color as exposed in Table 2.

Table 2: Classification of discoloration/dyscromia on the basis of color.

The treatment of extrinsic pigmentation is based on dental abrasive polishing. The professional methods most used are:

The air polishing with the use of jet of water and baking soda in which the abrasive cleaning action of baking powder at high pressure, that mechanically removes pigmentation, is used;

Rubber cups and nylon brushes mounted on low speed handpiece are associated with abrasive pastes in which the abrasive paste and the rotary movement have a synergic action;

Ultrasonic scalers exploit the vibrating action to remove plaque, tartar and pigments;

While abrasive paper strips and floss associated with abrasive pastes are used for the treatment of pigmentation in interproximal spaces.
The professional methods used for the treatment of intrinsic pigmentations are distinguished by evaluating the discoloration and the vitality of teeth. Whitening treatment of non-vital teeth are: the thermo- catalytic technique and photo walking bleaching technique. These two techniques have similar patient preparation: setting of dental dam, removal of previous restorations, dressing the pulp chamber, the application of cement to protect dentinal tubules to prevent the spread of bleaching agents into periodontium, bleaching agent application.

After the application of the whitening agent, the two techniques are distinguished in:

1. Thermo-photo catalytic technique that accelerate the reaction of bleaching using a spreader or an excavator heated on flame (but not hot) or a halogen lamp with focused beam on the tooth. This operation is repeated up to 4-5 times in the same session.
2. Walking bleaching technique, after placing the mixture into the cavity the bleaching reaction is not accelerated, and the mixture is compressed with a wad of cotton so as to absorb the hydrogen peroxide in excess then left in situ for a period of time (about 7 days).

Both techniques involve the repetition of treatment until the desired result is obtained. Thereafter a permanent composit restoration is performed. Vital-tooth whitening treatments are "Assisted Power Bleaching" and "Home Bleaching" technique. In the Assisted Power Bleaching technique is expected, as in any dental whitening procedure, the protection of soft tissues of the oral cavity and then, after cleansing the buccal and incisal surfaces of the teeth to be treated, the whitening high concentrated agent application. Therefore, in order to accelerate the whitening reaction, a beam of light produced by specific lamps is directed to dental surfaces and has the ability to accelerate the chemical reaction produced by bleaching agent. This procedure can be repeated up to 4-6 times depending on obtained results. Obviously, the application timing of bleaching agent will vary depending on its concentration and on the power of the used lamp. It should however be noticed that, nowadays, many dentists tend to use less lamps activated whitening procedures rather than other procedures that do not require them. In addition, many authors have shown that there are substantial differences in obtained results with the two different methods, and it has been shown that the use of heat, laser, plasma lamps, high intensity halogen lamps, do not produce a significant increase of the peroxide dissociation reaction in the temperature range used clinically.

Carbamide peroxide or Urea peroxide is a organic peroxide and is composed of hydrogen and urea peroxide in equimolecular proportions. It appears as a white powder soluble in water, with remarkable bleaching and antiseptic properties. Its chemical formula is as follows: NH₂-CO-NH₂ -- H₂O₂. and is degraded to 33% of Hydrogen peroxide and 77% of Urea peroxide; Hydrogen peroxide is the active component while Urea is degraded to carbon dioxide and ammonium. Carbamide peroxide has the same mode of action of the hydrogen peroxide, described above, while urea is directly responsible for the anti-plaque effect. Sodium perborate (NaBO₂ H₂O₂ - H₂O -3) is a sodium salt of boric acid coordinated with hydrogen peroxide. The bleaching action is due to the action of hydrogen peroxide. The present study aims to provide a standardized clinical protocol for dental home bleaching of intrinsic discolorations.

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The home bleaching technique involves the use of an individualized template device, inside which a few drops of 10% carbamide peroxide or hydrogen peroxide to 3-6% are placed at each element to be treated. This treatment is performed as not outpatient procedures. Dental whitening techniques involve the use of specific substances which through a chemistry reaction, are able to disrupt the chromophore groups responsible for dental pigmentation, making the external enamel surface whiter. Therefore the techniques used are based on oxidative processes; these are capable of breaking the double bonds of the compounds present inside and outside the teeth, thus preventing color emission. The most used substances are hydrogen peroxide, carbamide peroxide and sodium perborate: hydrogen peroxide (H₂O₂) is an inorganic compound that contains a double bond (o= o) and during the reaction phase (H₂O₂ --- > 2H₂O + O₂) releases oxygen, this creeps into the porous enamel structure up to reach the level of the dentin-enamel junction, decomposing the molecules of pigment nested therein, in simpler and colorless particles. The progression of the bleaching process leads to a saturation point, in which only hydrophilic colorless structures persist, so that the mechanism of bleaching cease.

Results

The purpose of this article is to provide a standard clinical protocol for Home Bleaching whitening teeth
technique with intrinsic discoloration as it follows.

Clinical protocol:

Like any dental treatment, also the home bleaching must respect the canonical points of anamnesis, diagnosis, treatment plan, therapeutic treatment phases/sessions, evaluation and periodic maintenance.

• Anamnesis: clarification of patient's expectations; this phase allows the operator to get an idea about the origins and onset timing of discoloration.

• Diagnosis: type, location, intensity of the discoloration, enamel quality and thickness; quality of existing filling restorations; situation and depth of the marginal periodontium; susceptibility test; periapical radiographs to evaluate pulp cavity amplitude, presence of fractures, root canals quality and apex state of development;

• Information and motivation: inform the patient about the possibilities, limitations and side effects of the procedure. Since it is a "cosmetic" treatment, it would be appropriate to sign an informed consent; inform the patient about the need of remaking any pre-existing restorations and the possible recurrence and re-treatment within 1-3 years after;

Treatment plan:

• Initial preparation: heal the deep and marginal periodontium; perform a session of oral hygiene; remove carious lesions or incongruous restorations, do not perform final restorations but temporary fillings (eg CVI or compomer);

Therapeutic phases/sessions

• First session:

- Photographic documentation of the initial situation with reference to the Vita color shade scale is provided: with a normal chromatic scale, the actual color grade shade of patient's teeth is established and colored photographs are taken in order to have comparative parameters before and after treatment.

- Alginate impression tray of dental arches are taken to construct individual templates; their model cast are performed, on the basis of which, in vacuum environment, a 2 mm thick soft plastic or soft resin device are made out of them.

Template must include all of the teeth in the same arch, leaving as much as possible free palate and gingiva; in fact, templates are generally cut to 1-2 mm from the free gingival margin to minimize the contact between gums and the whitening gel that may produce soft tissues irritation. It is necessary that these templates exactly reproduce teeth morphology and that leave blank space on the buccal surface and on the incisal edge of teeth that have to be treated, in order to allow the placement of the bleaching solution. To realize these box spaces, the technician will have to brush the buccal surfaces and incisal edges on the model cast with die varnish in order to create niches in which to introduce the whitening gel.

• Second session:

- Template proof, having particular attention to possible contacts with marginal tissues, borders do not have to compress gums and sharp edges has to be smoothed and correct through a low speed handpiece.

- Templates are filled with bleaching agents used for the treatment.

This second session serves also to explain and provide the patient procedure instructions.

- Educate the patient on atraumatic insertion and removal of the template.

- Instruct on proper filling of the template with the gel, on not overfilling and removing gel excess with a toothbrush or a cotton swab: whitening material syringes (3-6 % hydrogen peroxide or carbamide peroxide, 10 % ) are supplied to the patient for a weekly treatment; previous tooth surfaces cleaning is required for the application of templates.

- Method of treatment: the patient starts with carrying template for 1-2 hours a day. It is not necessary to exceed with time application as many studies have shown that the action of whitening products is highest in the first two hours of treatment and then tends to decrease drastically in the following hours. Dentist prescribe a fluoride gel to be inserted in the template and carried 1-2 hours per day, after using the template with the whitening gel to prevent a possible hypersensitivity. In more hypersensitive patients the alternation of fluoride gel and the whitening gel is recommended.

- Third session: Monitoring of results and of possible side effects; consignment of additional syringes of whitening material if the results were not satisfactory; usually after three weeks of treatment, the therapy is considered concluded.

- Fourth session: the last session takes place a week after the last application of the gel:
- Photographic documentation of the final situation with reference to the Vita color shade scale corresponding to the initial situation is required;
- Finally, any aesthetic restorations are hence performed;

Evaluation and periodic maintenance:

In the last session, the patient is recommended to perform periodic revaluations to check the stability of the obtained results and to avoid relapse.

Discussion

Therefore we can outline the pros and cons of Home Bleaching whitening technique as listed below.

Disadvantages:

1. Dentinal sensitivity: an increased sensitivity is observed during and after treatment in two thirds of patients undergoing whitening procedures on vital teeth. It is related to a reversible pulpitis triggered by whitening agents and amplified by dental dehydration. Thus can be resolved through the application of topical fluoridation - that leads to the occlusion of dentinal tubules and the reduction of dentinal fluid - or through the application of potassium nitrate which has an analgesic effect on the transmission of the nervous impulse, or else with the administration of analgesics.
2. Soft tissue irritation: peroxides can cause cellular damage, gingival ulceration and mucosal/skin burning sensation. Clinically, it is possible to appreciate the appearance of a reddish patch that then fades to a light-colored lesion. Usually, these lesions tend to resolve themselves quickly without leaving permanent damages. However, they can be avoided by making a careful inspection of the vacuum formed template to exclude the presence of border imperfections that may get in contact with soft tissues and by instructing the patient to remove gel excess before and after the insertion of the preformed template.
3. Alteration of composite fillings and composite - enamel interface surface texture: several studies have shown that there is a reduction in the strength of the bond between composite resin and enamel where bleaching has been performed. An hypothesis is that the presence on enamel surface of hydrogen peroxide interferes with the resin bond and its polymerization. In order to avoid such event, it is sufficient to instruct the patient to clean the enamel - composite surface after using the whitening template.
4. Reduction of enamel and dentin microhardness: several authors have highlighted the possibility that hydrogen peroxide can cause dentin and enamel structural alterations. It has to be noticed that many of these studies have been performed in vitro, therefore, they do not consider the remineralization that could occur, in vivo, in the oral cavity subsequent to saliva exposure. The reduction of enamel and dentin microhardness, when exposed to bleaching agents, is clinically not significant and able to regress spontaneously after the interaction with salivary electrolytes. Studies conducted on Carbamide peroxide (10 %) have shown that the application of this bleaching product on the enamel surface produces local microstructural modifications similar to those seen in initial caries. Moreover, the enamel calcium ions proportion lost amounts to 1 microg/mm2 which is clinically a not significant value. Furthermore, this situation can be further resolved with remineralizing topical applications of fluorine-based products.
5. Patient compliance: home whitening procedures cannot be controlled by the operator; therefore, the patient may perform it incorrectly due to lack of cooperation. However, it has been statistically proven that those who ask for whitening treatments are highly motivated and this is due to the awareness that a shining smile can increase self confidence and self-esteem and give positive social feedbacks.

Advantages:

1. Time and treatment costs containment: the treatment bleaching action takes place at home, saving work time for the dentist and having a consequent costs reduction for the patient as well.
2. Use of mild aggressive substances: an additional benefit of Home Bleaching is due to the fact that no chemicals strong caustic substances are used; so the use of liquid dam, thermocatalitic means and whitening lamps are not necessary. Thus have positive outcomes on the reduction of costs and treatment side effects.
3. Anti-plaque effect of Carbamide peroxide: Carbamide peroxide releases Hydrogen peroxide and urea. Only urea is responsible for the anti-plaque effect: splitting up into carbon dioxide and ammonia, causes an increase of oral pH that hinders plaque formation.
4. Therapy results: the literature indicates that the level of whitening achieved by this method, even if it is not generally predictable, are better than those obtained with conventional outpatient bleaching techniques.
Table 3: Advantages and Disadvantages of Home Bleaching.

Conclusions

The last two decades has been characterized by a massive eruption of myths and fads that have changed the concept of aesthetics of the head and neck district. Color harmony of the smile plays a fundamental role in patients’ aesthetics that is reflected on behavioral attitudes. Dental dyscromia represents a psychological discomfort for the patient and this is the reason why we witness the increase of cosmetic whitening demand. Considering whitening techniques and in particular the home bleaching technique with its advantages and disadvantages, in our opinion is a valid alternative and a useful aid to other whitening techniques in treating severe intrinsic discoloration, difficult to resolve.

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# Illustrations

## Illustration 1

Table 1. Major extrinsic and intrinsic discolorations.

<table>
<thead>
<tr>
<th>Extrinsic discolorations</th>
<th>Intrinsic discolorations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>bacterial origin:</strong> White - yellow pigmentations</td>
<td><strong>post- eruptive:</strong> necrotic teeth (pink, gray and finally brown tooth color), endodontic materials (that produce different tooth color), tooth decay (brown and black spots) and fillings (pigmentation color tending to black).</td>
</tr>
<tr>
<td><strong>Green pigmentations</strong></td>
<td><strong>pre- eruptive:</strong> Dentinogenesis imperfecta (teeth color varies from blue to brown), Amelogenesis imperfecta (yellow and brown discolorations), Fluorosis (localized or diffuse spots ranging from milky white to brown), Enamel hypoplasia (whitish spots), tetracycline intake (yellow - brown pigmentation), trauma (Turner's tooth, that is associated to yellowish-white spots) and systemic diseases (Phenylketonuria that causes brown or black pigmentation, Congenital erythropoietic porphyria that causes reddish brown teeth, Erythroblastosis fetalis that produces dental yellow - green stains).</td>
</tr>
<tr>
<td><strong>Orange pigmentations</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Brown pigmentations</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Smoking:</strong> brown - black discolorations</td>
<td></td>
</tr>
<tr>
<td><strong>Food and beverages:</strong> brown - black discolorations</td>
<td></td>
</tr>
<tr>
<td><strong>Chemical or metal substances:</strong> brown, blue - green discoloration</td>
<td></td>
</tr>
</tbody>
</table>

Illustration 1
Illustration 2

Table 2: Classification of discoloration/dyscromia on the basis of color

<table>
<thead>
<tr>
<th>COLOR</th>
<th>ORIGIN OF DYSCROMIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>White Spot; initial Fluorosis; Amelogenesis imperfecta</td>
</tr>
<tr>
<td>Blue / White</td>
<td>Hyperthyroidism; Iron deficiency anemia</td>
</tr>
<tr>
<td>White / Yellow</td>
<td>Turner's tooth; dentin dysplasia; hyperadrenalism; spices</td>
</tr>
<tr>
<td>Yellow / Grey</td>
<td>Hypoadrenalism; erythroblastosis fetus</td>
</tr>
<tr>
<td>Yellow / Brown</td>
<td>Amelogenesis imperfecta</td>
</tr>
<tr>
<td>Pink</td>
<td>Root resorption</td>
</tr>
<tr>
<td>Orange</td>
<td>Carrots;</td>
</tr>
<tr>
<td></td>
<td>Bacillus Prodigiousus; Mirococcus Roseus Flavobacterium Lutescens; Sarcina Rosea; Bacillus Mesentericus Rubens</td>
</tr>
<tr>
<td>Green</td>
<td>Hypoadrenalism, spinach (chlorophyll)</td>
</tr>
<tr>
<td></td>
<td>Pyocianicus Bacillus, Penicillium glaucum; Aspergillum</td>
</tr>
<tr>
<td>Green / Blue / Black</td>
<td>Root canals; traumatisms, copper, brass, nickel</td>
</tr>
<tr>
<td>Brown / Blue</td>
<td>Ferrenica Anemia; Thalassemia; Hypothyroidism; AKU; Stannous fluoride; chlorhexidine; quaternary ammonium compounds; esetidina; delmopinolo; iron; cadmium. Dentinogenesis imperfecta.</td>
</tr>
<tr>
<td>Brown / Red</td>
<td>Erythropoetin congenital porphyria.</td>
</tr>
<tr>
<td>Brown / Black</td>
<td>Tetracycline; Amelodental decay (advanced stage); Phenylketonuria. Smoking; Bacteria; Coffee; Tea; Tooth not vital root; Canal medicaments.</td>
</tr>
<tr>
<td>Brown / Blue</td>
<td>Dentinogenesis Imperfecta.</td>
</tr>
<tr>
<td>Grey</td>
<td>Saturnism; Tooth Not Vital.</td>
</tr>
<tr>
<td>Grey / Black / Green</td>
<td>Silver amalgam.</td>
</tr>
</tbody>
</table>
Illustration 3

Table 3. Advantages and Disadvantages of Home Bleaching.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Time and treatment costs containment</td>
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<tr>
<td>Therapy results</td>
<td>Reduction of enamel and dentin microhardness</td>
</tr>
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<td></td>
<td>Patient compliance</td>
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</tbody>
</table>