Tooth Discoloration and Bleaching

Tooth discoloration is defined as "any change in the hue, color, or translucency of a tooth due to any cause; restorative filling materials, drugs (both topical and systemic), pulpal necrosis, or hemorrhage may be responsible. The discoloration may be induced by intrinsic stains incorporated in tooth structures and extrinsic stains deposited on tooth surfaces.

Bleaching is a procedure which involves lightening of the color of a tooth through the application of a chemical agent to oxidize the organic pigmentation in the tooth.

Classification of discoloration

Patient related discoloration

a) **Pulp necrosis**: is one of the most common causes. The longer the pulp has been necrotic, the more intense is the discoloration. Necrotic tissue contains various protein degradation products which may penetrate the dentinal tubules and create a greyish brown discoloration of the crown. This responds well to intracoronal bleaching (non-vital bleaching technique).
b) **Intrapulpal hemorrhage**: Trauma can cause haemorrhage as blood vessels rupture in the pulp chamber. Blood is hydraulically driven into the dentinal tubules, where the RBC undergo haemolysis. liberating haemoglobin. Haemoglobin is degraded releasing iron that forms a black compound by combining with hydrogen sulphide to become iron sulphide. Immediately after injury, crown remains pink as blood breaks down. The tooth becomes orange, then blue, then brown or black. Treatment is by intracoronal bleaching (non-vital bleaching technique).
c) **Dentine-hypercalcification**; Due to trauma, the pulp may form dentine rapidly to decrease the volume of the pulp. Such new dentine increases the yellow appearance of the tooth. Treatment starts with extracoronal bleaching (vital bleaching technique), and in case the discolouration problem was not resolved, more aggressive treatment is needed as root canal therapy followed by either intracoronal bleaching or tooth covering with veneer or crown.
d) **Age**: In old aged teeth, certain problems occur to the tooth such as physiological dentine apposition, thinning and cracking of enamel and incisal wear of the tooth. Advantage in older patients pulp recession makes aging a boon in terms of extracoronal bleaching, since, it makes the patient less sensitive to bleaching.

Tooth related Causes

a) Developmental defects Discolorations may also result from development defects or from substances incorporated into enamel or dentin during tooth formation.
    - Enamel hypocalcification: is common, appearing as a distinct brownish or whitish area, often on the facial aspect of a crown. The enamel is well formed and intact on the surface and feels hard to the explorer. Both the whitish and the brownish spots are amenable to extracoronal bleaching.
    - Enamel hypoplasia: The enamel surface is defective and porous. It may be hereditary as amelogenesis imperfect or due to environmental factors may involve only one or several teeth. Presumably during tooth formation, the matrix is altered and does not mineralize properly. The porous enamel readily acquires stains from the oral cavity. Treatment can start by extracoronal bleaching and later conservative treatment to repair the porous surface.

b) Systemic conditions
    - Erythroblastosis fetalis: It happens due to Rh incompatibility of blood in new born babies. Large amounts of hemosiderin pigment (an iron-storage complex) are released and discolour the dentine. Stain is usually green, brown or blue.
    - Sickle cell anemia: It is an inherited blood dyscrasia, which cause intrinsic bluish, brown, or green discolorations. The discoloration is similar to erythroblastosis fetalis but more severe.
    - Amelogenesis imperfect: It causes yellow to brown discoloration.
    - Dentinogenesis imperfect: It causes brown, yellow or grey discoloration. These conditions are not amenable to bleaching and should be corrected by restorative procedures such as composite build-up or crowns.

Drug related discoloration

There are certain drugs that cause tooth discolouration when ingested during its formation.

a) Tetracycline Discoloration of this type occurs after tetracycline ingestion, usually in children. Discoloration is bilateral, affecting multiple teeth in both arches. Color change ranges from light yellow to darker grey to brown depending on the dosage, duration of intake and age of the patient at time of administration of the drug. Tetracycline binds to calcium and gets incorporated

to hydroxyapatite crystals of enamel and dentine. Treatment may be achieved by extracoronal alone or intracoronal bleaching following intentional root canal therapy.

b) Endemic fluorosis Intake of large amount of fluoride during tooth formation may produce defect in enamel matrix causing hypoplasia. It is seen as white spots ranging from chalky white to brown discoloration. Treatment is done by extra coronal bleaching with restorative therapy of the porous surface.
c) Chlorhexidine this is a surface stain after prolonged use of chlorhexidine mouthwash. It ranges from yellowish to brown color. Treatment is achieved by extracoronal bleaching.

Dentist related discoloration

a) Discoloration related to endodontic
    - ❖ Pulp tissue remnants: if some pulp tissue remains in the pulp chamber especially the pulp horn, discoloration occurs due to tissue and blood decomposition.
    - ❖ intracanal medicaments: excessive use of phenolic or iodoform based medicaments may create brown, yellow or orange stains in the dentine.
    - ❖ Obturating materials: gutta-percha has to be removed from the pulp chamber to prevent tooth discoloration. Root canal sealers containing silver may cause black stains.

      The abovementioned causes of discoloration are considered intrinsic because it affects inner structure of the tooth, and they respond well to non-vital bleaching technique
b) Discoloration related to Restoration
    - ❖ Amalgam: silver alloys have long been condemned for staining dentin a dark grey.
    - ❖ Pins and posts: Metal pins and posts may show through the composite restoration or cause blue greyish stains of the composite filling.
    - ❖ Composite: Microleakage around a composite filling may discolor the tooth due to the entrance of bacteria and fluids through the gap between the tooth and the filling.

    Treatment of the abovementioned causes is replacement of the filling.

Bleaching Materials

Bleaching compounds may act as either oxidizing or reducing agents. Commonly used agents are solutions of hydrogen peroxide, sodium perborate, and carbamide peroxide.

Both sodium perborate and carbamide peroxide release hydrogen peroxide after their gradual degradation. Hydrogen peroxide and carbamide peroxide are mainly indicated for extracoronal bleaching, whereas sodium perborate is mostly used for intracoronal bleaching.

- **Hydrogen peroxide**: is a powerful oxidizer that is available in different Concentration. Superoxyl and Perhydrol of 30% to 35%concentrations respectively are the most common used solutions. Although hydrogen peroxide will bleach quickly, it should be handled with care as it has a caustic and burns effects on soft tissue in contact.
- **Sodium perborate**: It is available in powder form, which is stable when dry, but in the presence of water, acid, and worm air it decomposes to form sodium metaborate, hydrogen peroxide and oxygen. It is safe and easily controlled so it is used in intracoronal bleaching.
- **Carbamide peroxide**: It is also called urea hydrogen peroxide (3 - 35%). Popular agent contains 10% carbamide peroxide, which breaks down into urea, ammonia, carbon dioxide, and approximately 3.5% hydrogen peroxide.

Mechanism of bleaching action

Mechanism of bleaching is mainly linked to degradation of high molecular weight complex organic molecules (stain) that reflect a specific wavelength of light that is responsible for color of stain. The resulting degradation products are of lower molecular weight and composed of less complex molecules that reflect less light, resulting in a reduction or elimination of discoloration. Bleaching agents act on the organic structure of the dental hard tissues, slowly degrading them to by-products as carbon dioxide. Inorganic molecules do not react with the bleaching agents. Bleaching action is also called oxidation-reduction reaction or redox reaction which is formed by cleavage of either an 0-H bond or the 0-0 bond in hydrogen peroxide to give H + OOH and 2OH (hydroxyl radical), that oxide or reduces other organic molecules.

Extracoronal (vital) bleaching techniques

- In-office bleaching
    - Pumice the teeth to clean off any debris present on the tooth surface.
    - Isolate the teeth with rubber dam.
    - Saturate the cotton or gauze piece with bleaching solution (30-35% H2O2) and place it on the teeth.

- Uses heat and light to activate bleaching material (Curing Light, Plasma Arc Light,laser).
- Change solution in between after every 4 to 5 minutes.
- Remove solution with the help of wet gauge.
- Repeat the procedure until desired shade is produced.
- Remove solution and irrigate teeth thoroughly with warm water.
- Polish teeth and apply neutral sodium fluoride gel.
- Instruct the patient to avoid coffee, tea, etc. for 2 weeks.
- Second and third appointment is given after 3-6 weeks.

❖ Mouthguard bleaching

- Mouthguard bleaching may be carried out in the dentist's office and at home by the patient. The product most often used is carbamide peroxide, and the percentage ofperoxide ranges from 10 to 35%.
- Take the impression and make a stone model.
- Apply separating media on the cast model.
- Material used for fabrication of bleaching tray is flexible plastic. Most common tray material used is ethyl vinyl acetate.
- Cast the plastic in vacuum tray forming machines.
- Trim and polish the tray.
- Checking the tray for correct fit, retention and overextension.
- Demonstrate the amount of bleaching material to be placed.
- If the product is being used in the office, the 35% carbamide peroxide gel is applied to the tooth indentations in the guard, which is then inserted into the patient's mouth for 30 minutes at a time. When used at home, the l0% gel is used and the guard may be in place 3 or 4 hours at a time, with the gel replaced every 2 hours. Many patients wear the guard all night.
- Treatment should take from 4 to 24 weeks, depending on the severity of the staining.

Intracoronal (nonvital) bleaching techniques for endodontically treated teeth

The protocols commonly used to bleach root canal treated teeth are the thermocatalytic and walking bleach techniques.

❖ Thermocatalytic technique this technique involves placing the bleaching agent in the pulp chamber and then applying heat, which supplied by heat lamps, flamed, instruments, or electrical heating devices.

- Isolate the tooth with rubber dam.
- Prepare an access opening and remove any gutta-percha or filling material from the pulp chamber.
- Place bleaching agent (H_2O_2 or sodium perborate or both) in the tooth chamber.
- Heat the agent with heat by a heat source (heat lamps, flamed, instruments, electrical heating devices, hot stick or light source).
- Repeat the steps until bleaching gives satisfactory results.
- Wash the pulp chamber with water, and then seal the tooth with cotton pellet and temporary material.
- After 2-3 weeks, recall the patient to analyse the bleaching results.
- Place suitable filling material to seal the tooth cavity permanently.

❖ Walking bleaching technique.

- This technique is the safest and requires the least chair time.
- Isolate the tooth with rubber dam.
- The restorative material is removed from the access cavity, and any guttapercha or filling material should be removed from the pulp chamber.
- Sufficient layer (2 mm thickness) of protective cement barrier (polycarboxylate, zinc phosphate, glass ionomer) is applied on the obturating material. This is essential to minimize leakage of bleaching agents.
- Place a freshly mixed sodium perborate/water mixture in the pulp chamber.
- Place a temporary filling to seal the access opening
- Recall the patient after 1-2weeks and repeat the treatment when needed.
- After completion of bleaching, close the access opening with composite material.

In case the discoloration is internal and external, a combination treatment can be done by:

A. Intracoronal bleaching and in-office bleaching (placing H_2O_2 on the facial surface and placing a heat source)
B. Intracoronal bleaching and home bleaching using a night guard template and H_2O_2 gel.

Effect of bleaching agents on the tooth and surrounding structures

1. **Tooth sensitivity**

This is mostly seen with in office technique/ H_2O_2 with heat This may be due to penetration of the bleaching agent into enamel and dentine and junctions with restorations.

2. **Effect on enamel**

Bleaching agents decrease enamel Hardness but fluoride application restores remineralization of enamel.

3. **Effect on Pulp**

When the bleaching agent penetrates the enamel and dentine it will cause transient reduction in pulpal blood flow.

4. **Cervical resorption**

When using H_2O_2 of more than30% concentration, external cervical resorption may occur.

5. Effect on composite

After bleaching, composite fillings may be affected by surface roughening of the restoration. Tensile strength is decreased and microleakage is more possible to occur.