



Vital tooth discoloration removal techniques: A literature review

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Abstract

Tooth discoloration is one of the most common findings now a days. Several factors have been found to be responsible for this. A variety of procedures are available now a days for tooth discoloration from microabrasion to veneers. The main focus should be on as conservative as possible treatment so maintain the natural tooth structure.

Keywords: bleaching, discoloration, esthetic, resin, treatment

1. Introduction

In today's competitive world, esthetics plays an important role in personal grooming and presentation [1]. Aesthetic dentistry is where science and art combine in dental treatment [2]. Discolored teeth are among the biggest hurdle of a beautiful smile. Therefore tooth colored restoration are in vogue and their demand is increasing day by day [3]. The possibility for innovative use of esthetic material are multiple [4]. Discolorations which are stumbling block to esthetics can be removed with microabrasion, bleaching veneers etc [5]. Today's esthetic dentistry seeks to improve the appearance of patients smiles with minimal invasive approach [6]. Discoloration being the prime cause of esthetic dental treatment, etiology should be known to the clinician. Discoloration being the prime cause of esthetic dental treatment, etiology should be known to the clinician [5].

2. Discussion

Conservative approach should be practiced for esthetic dentistry. Adhesive technologies not only satisfies the patient's restorative needs and aesthetic desires but it also preserve as much tooth structure as feasible. With indirect restorations, clinicians should choose a material and technique that satisfies the patient's aesthetic, allows the most conservative treatment, biological and structural requirements and provide clinical durability [7]. All treatment must be based on the basic rules of dental care. First, normal function of the dentition must be guaranteed over the long term. Second, all harm must be excluded, finally all treatment must result in acceptable masticatory function.¹

2.1 Various techniques of removal discolorations from vital tooth

Today's esthetic dentistry seeks to improve the appearance of patients smile with minimal invasive approach. With the development of dental science and esthetics, reaserchers came with new ideas of removal of stains from tooth [8].

There have been various techniques reported which removes the stains without causing much harm and improve the esthetics and enhance the smile of the patient [9].

The various techniques advocated are [5]

- Macroabrasion
- Microabrasion
- Bleaching
- Resin Infiltration
- Composites
- Veneers

2.2 Macroabrasion

It is a technique for the removal of localized, superficial white spots & other stains or defects [10]. The discolored enamel contains an increased amount of organic matrix, which is not an adequate substrate for adhesion of dental materials. When the lesion is generally restricted to enamel, its elimination will not result in exposure of dentin (Magne 1997) [11].

2.2.1 Technique [12, 13]

- Macroabrasion involves removing the outer layer of opaque enamel using a 12- fluted composite finishing bur or a fine grit finishing diamond in a high-speed handpiece with water-air spray.
- Light, intermittent pressure is used with careful monitoring of removal of tooth structure so as to avoid irreversible damage to the tooth.
- A 30-fluted, composite finishing bur is used to remove any facets or striations created by the previous instruments after removal of the defect or on termination of any further removal of tooth structure.
- Final polishing is accomplished with an abrasive rubber point.

Advantages [14]

- Faster and gross removal of the defect.

- Makes way for the active reagents of bleaching system to penetrate
- In severe enamel defects, macroabrasion combined with a minimally invasive adhesive resin composite restoration may present a valuable alternative to microabrasion.

2.3 Microabrasion

It is a procedure in which a microscopic layer of enamel is simultaneously eroded and abraded with a special compound usually contains acid, leaving a perfectly intact enamel surface behind [15].

Currently, 6.6% hydrochloric acid is used under the commercial product name of Opalustre (Ultradent Products Inc., South Jordan, UT, United States) [16].

Indications

Dental fluorosis, Correction of surface irregularities on dental enamel caused by imperfect enamel formation or acquired after orthodontic appliances removal, localized or idiopathic enamel hypoplasia limited to the outer enamel layer [15].

Contraindications

In patients with deficient lip sealing, deep opaque stains from hypoplasia, Age related staining, carious lesions underlying regions of decalcification [17].

2.3.1 Mechanism of action

Bertoldo *et al* (2014) recently reported that microabrasion with 6.6% HCl and silica results in the incorporation of chloride ions and silica into the enamel. Chloride ions are associated with enamel rehardening, as they are responsible for more than 60% of the ionic strength of saliva and silica is used in a bioactive material (Ca_3SiO_5) that efficiently induces a new apatite layer on acid-etched enamel [16].

2.3.2 Technique [18]

Step 1: Tooth surface was cleaned of debris and plaque with rubber cap and prophylaxis paste.

Step 2: Isolate the tooth with rubber dam and apply petroleum jelly to the tissues.

Step 3: 12 fluted carbide or a fine grit finishing diamond bur is used for Microabrasion. Along the anatomy of the tooth, bur is moved.

Step 4: Mix 12% HCl with pumice into slurry and a small amount is applied to the labial surface with a wooden stick, slowly rotating rubber cup or flat plastic instrument rubbed over the surface for five seconds. Washed into the aspirator directly for 5 seconds. The process is repeated till the stain is reduced, with a maximum of 10 × 5 second applications per tooth.

Step 5: Polishing of tooth with graded Soflex discs or proprietary polishing pastes.

Step 6: Casein phosphopeptides-amorphous calcium phosphate (CCP-ACP) application Precaution - Protective shield or eyewear should be used both by dentist and patient to avoid splatter.

Step 7: Re - evaluate the color of the tooth.

2.3.3 Post-operative Instruction [16]

Avoid staining beverages, proper brushing, Topical fluoride applications

Advantages [15]

No damage to pulp or periodontal tissues, Satisfactory and

permanent results, Non-invasive, No requirement of local anaesthesia, Less time consuming and Postoperative sensitivity or loss of vitality not treated

2.4 Bleaching

Tooth whitening is a procedure that lightens the tooth color [19]. Bleaching expands the scope of esthetic dentistry. It is less invasive method to lighten discolored teeth [20]. Bleaching techniques may be classified as to whether they involve vital or non-vital teeth and whether the procedure is performed in office or outside the office [19].

Constituents of Bleaching Gels [21]

- CP hydrogen peroxide and sodium hydroxide
- Non-hydrogen peroxide containing materials, that is, sodium perborate thickening agent Carbopol or polyx
- Urea
- Vehicle – glycerin, dentifrice, and glycol surfactant
- Preservatives flavoring fluoride.
- CP (urea peroxide)

Indications [22]

- Color changes related to pulpal trauma or necrosis
- Stains from tobacco staining
- Acquired and superficial stains
- Mild Fluorosis
- Tetracycline stains
- Age related discolorations

Contraindications [22]

- Teeth with insufficient enamel
- Defective restorations
- Sensitivity towards hot and cold
- Fractured tooth
- Teeth with large anterior restorations
- Pregnant and Lactating mother
- Severe fluorosis and hypoplasia

2.4.1 Bleaching techniques for vital tooth⁵

- Night guard vital bleaching
- Inoffice bleaching

-Thermocatalytic

-Nonthermocatalytic

In office bleaching of vital teeth (chair side bleaching, power bleaching, laser bleaching, dentist administered/applied bleaching, and assisted bleaching [Miller, 1999]/dentist supervised bleaching) [11].

1. Power bleaching [5, 23, 24, 25]

It accelerates, in office tooth whitening procedures using either a xenon plasma arc curing light or a laser.

Materials

35% hydrogen peroxide liquid.

35% CP.

Various concentrations or combination of the above materials.

Dual activated bleaching system. This material contains 35% hydrogen peroxide gel, which is both light and chemically activated.

Mechanism of power bleaching

The technique works by lightening the enamel to give the

appearance of whiteness. One theory is that the large colored organic molecules responsible for the stains are reduced to smaller, less noticeable molecules by a process of oxidation. The hydrogen peroxide acts both as an oxygenator and an oxidant.

Another theory is that the peroxide penetrates into enamel and dentin and oxidizes tooth discolorations. Nascent oxygen penetrates into enamel followed by dentin.

Procedure

Patient is assessed clinically and radiographically. Proposed treatment plan is discussed. Pre-operative photographs of teeth are taken. Teeth are isolated with a protective mucous membrane seal and gingiva is protected. Teeth are ligated with floss to protect the material from creeping under the dam. Teeth are cleaned with pumice prophylaxis paste. Bleaching material is now applied to the teeth. Light is applied close to the teeth. Teeth are then washed, and the bleach is reapplied for a further 10 min and the process is repeated for 45 min to 1 h. Teeth are polished with diamond polishing paste or aluminum oxide discs. Dam is then removed. Mouth is rinsed and shade of the teeth is now assessed. A post-operative photograph can be taken. Patient is called 3–6 weeks later and this process can be repeated in 6 weeks increment till the desired shade is achieved.

Waiting room bleach technique (assisted bleach technique)

About 35% CP (which breaks down to 10% hydrogen peroxide) is marketed as a power bleaching agent. The teeth are polished with prophylaxis paste. Cheek and lip retractors are placed. About 35% CP can also be heated gently by holding the syringe under hot running water for 2–3 min. Heat of the syringe accelerates the activity of the material before it is loaded into the mouth guard. The dentist applies 35% CP into a custom-made bleaching tray, followed by patient moving into waiting room for 30 min with bleaching tray in the mouth and then bleach is suctioned off the teeth before rinsing.

Other techniques such as compressive bleaching technique dual-activated technique, power bleaching techniques using heat, and the laser bleaching technique are more effective but less commonly used due to cost and feasibility.

Postoperative instructions for vital bleached teeth ^[26]

- Whitening toothpaste and dental floss with a powered toothbrush.
- To make the teeth appear whiter, women are advised to wear a brighter shade of lipstick.
- Avoid acidic drinks, tea, fruits, coffee, and smoking for 48 h after bleaching.
- Shade relapse might follow, so avoid disappointment. Quicker the drop of shade, more is the rebound.

2.5 Resin Infiltration

This technology seems to bridge the gap between minimally invasive and noninvasive treatment of initial dental caries, postponing the need for a restoration as long as possible ^[27].

The concept was first developed at the Charite Berlin and the University of Kiel as a micro-invasive approach for smooth surface and proximal non-cavitated caries lesions management. It is marketed under the name Icon® (DMG America Company, Englewood, NJ) ^[28].

2.5.1 Principal

Resin infiltration perfuse the porous enamel with resin by capillary action. The aim is to arrest the progression of

lesion by occluding the microporosities which provide diffusion pathways for acids and dissolved materials. Resins with high penetration coefficients (>200cm/sec) had shown superior ability to penetrate natural lesions as compared to resins with lower penetration coefficient. The masking effect of the white spot lesions is improved by using infiltrants with a refractive index closer to that of hydroxyapatite ^[29].

Indications ^[30]

White spot lesion and Mild fluorosis

2.5.2 Armamentarium ^[28]

Icon Etch (15% Hydrochloric acid), Icon Dry (99% ethanol) and Infiltrant (TEGDMA)

Steps

ICON® is marketed in two forms: Proximal surface and vestibular surface kits. The principle is similar in both except in case of proximal lesion treatment where there is need for separation ^[30].

Hydrochloric acid

Resin penetration into the lesion is hampered by the mineralized surface layer of the non cavitated lesions. Therefore, this should be removed. The penetration depth of 15% HCl etching is more than twice (58 μm) that of 37% phosphoric acid, enabling penetration into the deepest part of the lesion and eliminating the decalcified areas, preventing further attacks ^[30, 31].

Ethanol

The surface is then dehydrated with 99% ethanol (ICON Dry) to facilitate the drying process. Ethanol wet bonding technique is based on the fact that it will coax hydrophobic monomers to infiltrate into demineralized wet dentin or enamel and improve the penetration efficacy of the hydrophobic infiltrate (TEGDMA) to get a well-defined, resin-infiltrated layer. Recent studies have shown that it is possible to bond hydrophobic resin monomers to acid-etched dentin and enamel with a new technique called "ethanol wet bonding" ^[32, 33].

Resin application

In this step, light curing of the resin is done followed by a three minute application time. The application is repeated for another one minute and light curing of the the resin is done again. The excess resin is then removed and the surface is polished ^[34]. The resin is applied twice because of the shrinkage of the material after the first application resulting in the generation of space that can be then occluded by a second application ^[30]. Infiltrated lesion polishing improved the masking effect stability due to reduction in surface porosity and possible removal of inhibition layer of the oxygen ^[35].

Advantages

Painless, No post-operative sensitivity & pulpal inflammation, improved esthetics outcome, Cost effective, Preservation of tooth structure. Immediate procedure, No shade matching required and reduces risk of gingivitis and periodontitis ^[30].

2.6 Composite

Composites are currently used successfully for correction of

minor esthetic defects such as unsightly anterior teeth with poor color and shape, faulty restorations and minor lack of alignment^[36]. Opaquers are fluid dimethacrylate resin typically light cured that contain strong pigments to give them a distinct hue, saturation and opacification ability. Opacifiers are used to mask a dark axial wall that would otherwise be visible or to incorporate subtle tones in restoration^[37].

Advantage

The tooth surface to be treated in accordance with the invention must be clean so that no significant amounts of plaque, calculus, surface film or pellicle, or the like must be removed^[37].

2.6.1 Shade matching^[38]

Shade selection is a visual perception and is purely subjective. To the untrained eye, color of a tooth is white or yellow. A simple exercise can help read the tooth color in a better way:

- The perfect source for shade selection is natural light or a good light source that is neither too intense or dull
- Observe the color of patient's teeth for 2 sec
- Read the color and register it in your mind
- Then look at some blue or white area for 5 seconds
- Ask the patient to roll the tongue over the teeth to make them moist and look again at the concerned region.
- See if it looks bright and shiny or has dull and matt look

2.6.2 Mock build

The mock-up will serve the purpose to get a preview of the aesthetic and functional outcome of a case and also for the patient's satisfaction. To get an instantly better preview of what the eventual outcome will be, the utilisation of a composite mock-up is wonderful as an aid^[39].

2.6.3 Bevel

A 40 micron diamond is used to smoothen out the jagged margins of the tooth and create a smooth bevel at the fracture line softening the edges and rounding off the fractured enamel prism^[40].

2.6.4 Etching

The etching solution is left in contact with the tooth surface for the usual period of time and is then rinsed with water. Whenever in enamel, use etch-and-rinse technique. Etching is usually with a 30-40% phosphoric gel that is rinsed away, promotes the dissolution of enamel rods, creating porosities (microtags) that are filled by bonding agents through capillary action and then polymerization of resin^[41].

2.6.5 Composite Placement

Flowable composite followed by opacifier was placed on the palatal half surface of tooth structure. Opacifier is used so that light doesn't pass through and providing adequate translucency. Shade of opacifier should be same as that of body color. Opacifier is applied at the cavosurface margin of fractured segment to mark the junction between the restoration and the tooth. Translucent layer should be placed on proximal region and incisal edge. Precurved matrix and sectional bands are used to make the contact^[42].

2.7 Porcelain laminate veneers

Mechanical and esthetic qualities and biocompatibility of

the porcelain, preservation of tooth structure, reliability and durability of the treatment and improved bonding strength made veneers a recommended and requested treatment for many patients^[43].

Indications^[44]

- Extreme discolorations in the anterior teeth
- Small enamel defects. E.g. cracks.
- Diastema and multiple spacing between teeth
- Fluorosis with enamel mottling
- Localized attrition and root sensitivity
- Functionally sound all ceramic or metal ceramic restoration with unsatisfactory color
- Malpositioned teeth and abnormalities of shape: Peg laterals and rotated teeth

Contraindications^[45]

- Insufficient coronal tooth structure
- Actively erupting teeth
- Patients with parafunctional habits like bruxism
- Endodontically treated teeth
- Reduced interocclusal distance
- Deep vertical overlap anteriorly

All Ceramic Systems used for Porcelain Laminate Veneers^[45].

Conventional ceramics, Castable ceramics, Machinable ceramics, Pressable ceramics and infiltrated ceramics.

2.7.1 Mock Build up^[46]

- Allows final visualization of the irreversible procedure
- Facilitate the communication between the clinician and the patient
- Fabrication of provisional restorations is a complimentary step. They accommodate the gingival tissue to the restorative material
- To preview the phonetics and occlusal comfort necessary at the end (v2) of the treatment

2.7.2 Shade Selection

Instead of precisely matching the shade, a shade of lower chroma and higher value could be selected. This allows for slight darkening which is attributed to increased translucency with polymerization of the luting composite cement^[44].

2.7.3 Tooth Preparation

Two major principles governs tooth preparation sounds Preparation must be as conservative as possible and retention is solely by adhesion rather than tooth preparation^[45].

Procedure

- Facial reduction

Teeth permit less reduction at the gingival finish line to a standard of 0.3 mm and the reduction at the incisal half and incisal edge to a standard of 0.5 mm, since the amount of enamel decreases at the cemento-enamel junction. Two diamond cutting burs will create the exact depth orientation grooves and round end tapered diamond bur is used to remove the remaining tooth structure. At the gingiva, slight chamfer finish line is established by the tip of the diamond bur^[47, 48].

- Proximal reduction

Proximal extension is just a continuation of facial reduction with the round end tapered diamond. At the line angle, adequate reduction is recommended and uneven finish line is avoided by keeping the bur parallel with the long axis of the teeth [45].

- Incisal reduction

Two techniques have been described for the placement of incisal finish line. In the first one, we terminate our preparation at the incisal edge and in the second one, the incisal edge is slightly reduced and the porcelain overlaps the incisal edges. The wrap around preparation will place the veneers in compression and will provide better results as the porcelain is stronger in compression than in tension. The multiwheel diamond burs are used to create 0.5-mm deep orientation grooves in the incisal edge and the remaining tooth structure is removed by round end tapered diamond [48].

- Lingual reduction

Lingual finish line is created by round end tapered diamond by holding the bur parallel to the lingual surface and forming a slight chamfer of 0.5-mm deep. Moreover, the lingual finish line depends on the thickness of the teeth and the patient's occlusion. Finishing is done further [45].

Provisional Restoration

Provisional restorations may not be essential as there is no dentin exposure and the proximal contacts are maintained. The two methods of provisionalization are:

Direct method using composite resin with central spot itching and autopolymerizing acrylic resin and indirect method after the cast fabrication [49].

Laboratory Procedures [45, 50].

Good communication with the laboratory with laboratory prescription, pre-treatment models, photographs of the teeth, and accurate impressions should be done. Laboratory fabrication techniques include

- Platinum foil technique
- Refractory die technique
- Computer-aided design-computer-aided manufacturing milling Veneer Try-in [45, 46]

Major three steps in try-in procedure include

- Dry try-in for marginal fit, where a retraction cord is placed to prevent the sulcular moisture or bleeding and each veneer is tried on the dry tooth surface for the marginal accuracy.
- Wet try-in for proximal fit, itched surface with water-soluble glycerin to minimize the vertical dislodgement is tried with all the teeth together for assessment.
- Resin cement try-in done for color matching. If the veneers are lighter than intended shade, darker or approximately same degree resin cement is recommended. One part of light opaque resin cement and 10 parts of light translucent resin cement are recommended, if it is darker than the intended shade,

Luting cement [51]

Treatment success depends on adequate bonding conditions between the veneers and the tooth complex.

Material used - flowable resin composite. This is a photocured material that minimally interferes with the esthetic stability of ceramic restorations.

Cementation

Resin cement of choice is according to the shade of the veneers and cementation is followed by proper retraction to avoid moisture control and contamination [45].

Finishing and polishing

The finishing and polishing of the cement line were performed with flexible aluminum oxide disks. To remove excess cement, polishing is done with a scalpel and abrasive rubbers. Occlusion assessment was done to make sure the lateral excursions and the anterior guidance and were correct, while obtaining even occlusal contacts throughout the restorations. (v3) [45, 46].

2.7.4 Recent Advances

Lumineers made from a special patented Cerinate porcelain is very strong but much thinner than traditional laboratory fabricated veneers are in trend currently. Lumineers are a reversible procedure and it hardly requires tooth structure removal. They will directly bond to the tooth making the bond very strong and the longevity is more as up to 20 years [52]. However, all the treatment is confined to ideal patients [45].

3. Summary and Conclusion

Tooth discoloration can have psychological impact on the patient. Also, it is one of the most common reason for the dental treatment. Although bleaching is a conservative procedure but there is post-operative sensitivity and relapse risk. So, a restorative approach with porcelain veneers and/or complete coverage crowns is required. It is imperative that the clinician have a comprehensive understanding of treatment options when treating a patient for tooth discolorations.

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