A Biomodification of Tooth Discoloration

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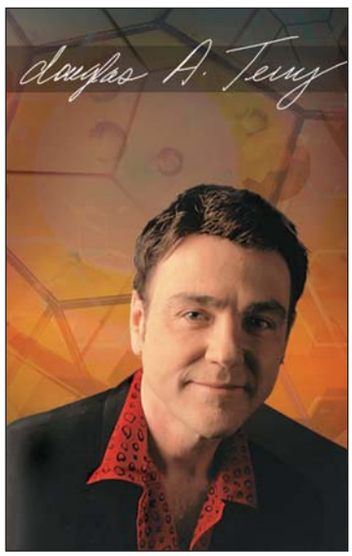
Contemporary emphasis on personal health and appearance is the catalyst for the demand of products and procedures that improve the appearance of teeth.[1] The influence of the media and public desire for cosmetic enhancement has stimulated short-term attractive smiles at the expense of long-term dental health.[2] Preserving and stabilizing the hard tissues requires more than a rudimentary understanding of new materials and techniques. It also requires the clinician to be aware of less destructive alternative restorative procedures to correct or improve the appearance of aesthetic deficiencies while incorporating a restorative philosophy of prevention, preservation, and perpetuation of longevity into their diagnosis and treatment planning.[3]



The clinician begins to correct restorative and aesthetic challenges by selecting a progressive treatment concept that begins with the most conservative restorative option and may progress to more invasive procedures as required.[2] Additionally, the method of informing patients to ensure proper decision making should be directed toward the long-term biomechanical risks associated with more invasive procedures. As presented in the previous discussion, modern restorative principles encompass a myriad of disciplines and conservative approaches that are available for numerous procedures. This discussion on the aesthetic correction of tooth discoloration will consider alternative conservative procedures.

Enamel Surface Discolorations

Correction of discolored teeth has been described in the literature since the 20th century.[4] Enamel discoloration can result from extrinsic and intrinsic staining and from abnormal mineralization. Extrinsic stains can be the result of accumulation and adherence of foreign particles on the tooth surface (eg, tobacco, wine). Intrinsic stains are caused by coloration agents entering the enamel and dentin or structural alterations by genetic or environmental stimuli (eg, dentinogenesis imperfecta, amelogenesis imperfecta, tetracycline discoloration).[1] Other forms of intrinsic staining are enamel dysmineralization[5] and enamel decalcification.[1] Enamel dysmineralization refers to enamel coloration defects that occur from a disturbance in the formation of the inorganic component of enamel during amelogenesis.[5] These enamel surface defects can exhibit white opacities, brown, yellow, or orange opacious spots and streaks, or multicolored superficial defects.[5,6] Enamel decalcification lesions occur when plaque persists on the enamel and the resulting organic acids etch the mineral content from the enamel surface. These lesions exhibit white colorations and, if left undisturbed, can result in caries (eg, brown colorations); these are usually associated with the area around resin-bonded orthodontic brackets and the cervical margins of all teeth.[1]

The successful elimination of discoloration depends primarily on the depth the lesion has penetrated the tooth's surface.[5] Although prevention is preferred, the precise etiology of the lesion often cannot be ascertained at the appropriate time, and for some intrinsic discolorations, the cause is unknown.[5] Restorative treatments of discoloration have included conservative to more invasive procedures, including chemical treatments (ie, bleaching), enamel microabrasion, direct composite resin, composite and porcelain veneers, and porcelain crowns. Treatment considerations should begin with the most conservative procedures and progress as needed to more invasive alternatives depending upon the depth of the lesion.

Conservative Color Correction

Conservative treatment considerations for correcting discoloration include dental bleaching and enamel microabrasion.[1,5,7] These procedures are considered to be less destructive alternatives to the mechanical removal of discolored enamel and its subsequent replacement with a restorative material.[8]

The difference between bleaching and enamel microabrasion is not only the chemical agent used for improving tooth color, but the results of the process. Bleaching is a chemical process of applying oxidizing agents on the tooth surface that penetrate the enamel and dentin and result in color alterations, but not in enamel reduction. Enamel microabrasion is a chemical and micromechanical method of reducing a microscopic layer of the enamel surface while eliminating superficial discolorations. Bleaching can therefore be used for transitory color correction by altering enamel and dentinal discolorations (ie, intrinsic tetracycline staining), while enamel microabrasion can provide a permanent elimination for some superficial enamel discolorations.[7]

A combination approach of using enamel microabrasion followed by patient-administered home bleaching applications can unify color correction, especially with discolorations such as decalcification, fluorosis, and fluorosis-like defects.[9]

Enamel Microabrasion

The microabrasion technique incorporates the use of an acid with abrasive particles to eliminate discolorations (Table). The treatment time for this procedure can be reduced by using rotary cutting devices such as fine diamond burs or abrasive finishing disks. The simultaneous action of the acid and abrasive particles in the compound (eg, PREMA, Premier Dental Products, Plymouth Meeting, PA; Opalustre, Ultradent Products, South Jordan, UT) combines an abrasive and erosive action that has been called the "abrosion effect."[10] This process removes the superficial layer of enamel and simultaneously compacts some of the residual abraded mineral byproduct into the enamel surface.[10] The newly formed smooth, dense mineralized layer at the enamel surface is approximately 15-µm thick[6] and has a glass-like texture and lustrous surface layer that has been designated the "enamel glaze."

After treatment, further superficial improvements may result from the continued remineralization process in the oral cavity, while the new optical properties of this mineralized layer have been shown to camouflage residual discoloration.[10] In addition, tooth hydration from the patient's saliva enhances the optical properties of this altered enamel. This enamel microabrasion procedure,

Figure 1. Pretreatment view of enamel decalcification and carious lesions related to dental plaque retention around previous orthodontic appliances.

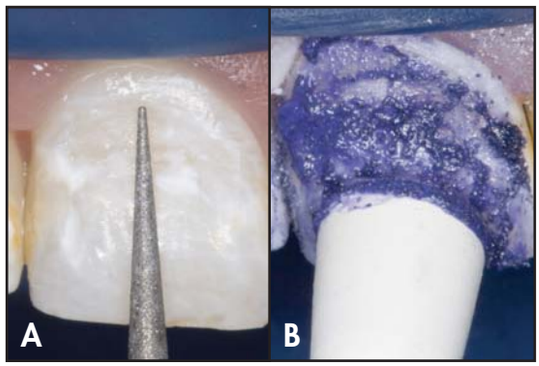


Figure 2A. Initial reduction of enamel surface with a diamond bur. 2B. Enamel microabrasion accomplished with a rotary application of slurry.

Table

Clinical Protocol for Enamel Microabrasion

- Evaluate the depth of discoloration and faciolingual thickness of affected tooth;
- Shoot preoperative photographs for documentation;
- Placement of dental dam;
- Initiate microreduction with fine-grit diamond bur;
- Application of microabrasion compound;
- Rotary application of compound, rinsing, and evaluation of discoloration;
- Repeat applications until discoloration is removed or discontinue and select another restorative option; and
- Apply neutral sodium fluoride gel for 4 minutes.

Figure 3. Immediate postoperative results following enamel microabrasion and application of 1.1% neutral sodium fluoride gel.

Figure 4. Final results after application of a hybrid composite resin.

in combination with fluoride treatment, may have the combined effect of inhibiting demineralization.[6] In vitro polarized light and scanning electron microscopic studies have shown that this "enamel glaze" surface is more resistant to demineralization and to colonization of Streptococcus mutans.[1,10] Additional benefits of this procedure include its conservative nature, its relative affordability for the patient, and the decrease in dental plaque accumulation; remineralization and potential preventative dentistry applications are also promoted.[9,10]

The determinant for treatment with microabrasion depends upon the depth of the enamel defect. The depth of discoloration can sometimes be determined by visual inspection of the affected tooth from the incisal; however, the depth of some defects can be elusive. The patient should thus be informed preoperatively that if this procedure does not eliminate the discoloration and/or the facial surface contour is altered to a flat or concave shape, an alternative procedure can be performed.

A combined therapy of microabrasion and composite bonding is one method that should be considered for those enamel defects that are too deep for elimination and for some dentinal discolorations (Figures 1 through 4). Prior to bonding, however, it is imperative that the microabraded enamel surface be prepared with a diamond bur and/or the etchant should be applied for 30 to 45 seconds longer than the normal specified time, since the mineralized enamel glaze has a tendency to resist the etchant.[11]

Conclusion

The chemical biomodification of tooth discoloration is a treatment modality that encompasses the three principle objectives of modern restorative dentistry: prevention, preservation, and the perpetuation of longevity. This treatment philosophy allows for a more conservative approach to aesthetic deficiencies that can often be provided without sacrificing the patient's tooth structure and the clinician's ethics.

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