A minimally invasive technique for the management of severely fluorosed teeth: A two-year follow-up

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INTRODUCTION

Dental fluorosis, which is a hypomineralization of enamel due to the effects of excessive fluoride intake, results in white opaque areas or discolorations ranging from yellow to dark brown together with surface porosities on the enamel surface.¹

Fluorosis staining is commonly considered an esthetic problem because of the psychological impact of unesthetic maxillary or mandibular anterior teeth.² A number of conservative or restorative techniques have been proposed for the esthetic management of fluorosed teeth, such as porcelain or composite veneers or crowns, enamel microabrasion, vital bleaching, or combinations of enamel microabrasion and bleaching.³⁻⁵ The treatment choice is affected by the putative cause, color, darkness, location and extent of the staining, as well as the number of teeth affected, the age, cooperation level and expectations of patient and the treatment trends of the period.⁶⁻⁷

In the past, enamel microabrasion and vital bleaching were preferred in the treatment of mildly or moderately fluorosed teeth without enamel defects,⁸⁻⁹ while fluorosed teeth with enamel defects were traditionally restored with laminate veneers or crowns.⁵⁻¹⁰ However, the more recent trend is toward “minimal intervention dentistry.” Since restorative intervention is often the starting point of a long series of re-restorations, commonly leading to crowns and implants, irrespective of how well the first restoration was prepared, minimally invasive techniques (enamel microabrasion and vital bleaching) may be

Case Report

Objective: Severely fluorosed and heavily discolored teeth that have large enamel defects give rise to esthetic concerns and require permanent treatment. In such cases, restorative techniques such as porcelain or composite laminate veneers or crowns are generally preferred, in which tooth preparation is inevitably required. Materials and Methods: This clinical report describes a patient with severely fluorosed teeth who was successfully treated with a minimally invasive technique including enamel microabrasion (6.6% hydrochloric acid slurry with silicon carbide micro-particles, Opalustre, Ultradent Products, Inc., South Jordan, UT, USA) followed by in-office bleaching (38% hydrogen peroxide, Opalescence Boost, Ultradent). Enamel microabrasion was conducted in two visits while three visits were required for in-office bleaching. Patient was followed-up after 2 years. Result: A slight staining had occurred during this period, but it was acceptable for patient. No adverse effects were observed. Conclusions: The minimally invasive technique including enamel microabrasion and in-office bleaching was efficient and may represent a good alternative to traditional restorative techniques for the management of severely fluorosed teeth.

Key words: Dental bleaching, fluorosed teeth, microabrasion
Enamel microabrasion removes the porous sub-surface enamel layer with the entrapped stains using a gel that contains hydrochloric acid (HCl). It eliminates white opaque areas and brown stains and smoothen the surface irregularities, resulting in a regular and lustrous enamel surface. However, teeth exposed to enamel microabrasion can acquire a yellowish or non-homogenous color after treatment since the remaining enamel surface becomes thinner. In these situations, color correction can be achieved by using the vital bleaching techniques. These remove brown stains, change the perception of opaque white areas by lightening the adjacent enamel surface and result in homogenous coloration of the tooth surface.

Enamel microabrasion

Before enamel microabrasion, oral hygiene instruction followed by scaling and polishing was performed. An initial photograph of the teeth was taken. Teeth were isolated with a rubber dam and then a fine-grit water-cooled diamond bur was used to sweep over the stained enamel region for 5-10 s. An approximately 1-mm thick layer of 6.6% HCl slurry with silicone carbide micro-particles (Opalustre, Ultradent Products, Inc., South Jordan, UT, USA) was applied to the affected tooth surfaces. OpalCups™ prophy cups (Ultradent) attached to a gear reduction contra-angle were used to microabrade the surface with slight pressure for 60 s at a time. Teeth were rinsed and this procedure was repeated 10 times for all teeth in two visits, which were 5 days apart.

A photograph was taken 24 h after treatment.

In-office bleaching

Patient received in-office bleaching 24 h after enamel microabrasion. Gingival protector gel (OpalDam, Ultradent) was applied along the gingival margin, overlapping approximately 0.5 mm onto the enamel, 4-6 mm high and 1.5-2.0 mm thick. It was light-cured for 20 s per arch by using a scanning motion. After mixing 2 syringes, a 0.5-1.0-mm thick layer of 38% hydrogen peroxide gel (Opalescence Boost, Ultradent) was applied to the labial surfaces of the teeth. After 20 min, the gel was removed using the suction and teeth were cleaned with water. These steps were repeated 3 times per visit. After a total of 3 visits, which were 5 days apart, the treatment was deemed to have concluded, because the third visit did not result in much improvement in appearance beyond that achieved after the second visit. After in-office bleaching, teeth were polished with abrasive discs and fluoride gel (Sultan Topex Neutral Fluoride gel, Englewood, NJ, USA) was applied for 5 min. Patient was instructed to use a casein phosphor-peptides-amorphous calcium phosphate (CPP-ACP) product (Tooth Mousse, GC, Tokyo, Japan) for 3 months. A photograph was taken.
had occurred, but patient satisfaction was high (VAS: 7) [Figure 5]. Tooth sensitivity or other symptoms of infection had evidently not occurred during the 2-year period. The teeth were vital and there were no signs of periapical lesion on the radiograph.

DISCUSSION

Although patients with mild-to-moderate fluorosis are not aware of the minor discoloration, severely fluorosed and heavily discolored teeth, which have large enamel defects, lead to esthetic concerns. Conservative treatment approaches such as enamel microabrasion and/or tooth bleaching can generally achieve considerable improvements by removing white opaque areas, brown stains and enamel defects, providing satisfactory results and eliminating the need for more invasive procedures.

Enamel microabrasion removes stained tooth structure with sub-surface porosities and improves tooth appearance by using an abrasive HCl paste. After enamel microabrasion, the surface layer is converted to a highly polished and densely compacted mineralized structure. The precise mechanism by which enamel microabrasion improves the surface structure of teeth is not completely clear. Two possible explanations have been proposed: (1) Acidic components dissolve the organic material and the loosely mineralized tissue and (2) newly microabraded surfaces reflect and refract light from teeth in such a way that mild discolorations in the underlying enamel are masked. The efficacy of using enamel microabrasion to treat fluorosed teeth has been studied through a number of case studies and clinical trials. This technique achieves improved appearance by removing the white opaque areas, brown stains and small enamel defects in mild and moderate fluorosed teeth.

RESULTS

A post-operative image taken after enamel microabrasion can be seen in Figure 3. After microabrasion therapy, the most of brown stains were removed, the surface seems smoothed and porosities eliminated due to enamel loss on teeth surfaces. However, in-office bleaching therapy after enamel microabrasion removed nearly all brown stains with the exception of some on the approximal surfaces and provided better and lighter color and a more homogenous appearance [Figure 4].

Patient satisfaction was considerably high after both treatments (VAS: 7). No tooth sensitivity was observed after enamel microabrasion, while mild gingival problems occurred (VAS: 3). Moderate tooth sensitivity (VAS: 4) occurred after in-office bleaching, but no gingival problems were present. The teeth were vital and no signs of tooth inflammation were evident on the radiographs.

Patient contact was attempted, but she was unavailable for over 2 years. Later, she returned to the clinic with a complaint about her posterior composite restoration and by this way patient was re-evaluated after 2 years. By this time, her extracted canines had been restored with fixed partial dentures as had maxillary right and left lateral incisors, canines, first premolars and left second premolar and first molar at a different dental clinic. A slight staining on the remaining treated teeth by 24 h after treatment. Patient satisfaction, tooth sensitivity and gingival problems were evaluated using a visual analog scale (VAS) ranging from 1 to 7 [Figure 2]. Post-operative radiographs were taken and the vitality of the teeth was re-evaluated.

«Tooth sensitivity» or «Gingival problems»

| No side-effects | Mild | Moderate | Severe |
|----------------|------|----------|--------|
| 1              | 2    | 3        | 4      | 5      | 6      | 7      |

«Patient satisfaction»

| Non-satisfied | Slight | Moderate | Very satisfied |
|---------------|--------|----------|----------------|
| 1             | 2      | 3        | 4              | 5      | 6      | 7      |

Figure 2: Visual analog scales
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Moderate cases. A clinical study revealed that this technique removed nearly all brown stains, while the reduction in white stains was 60-100%. A further clinical trial showed that enamel microabrasion with HCl-pumice paste resulted in a score of 5.38 for improvement of appearance and 5.06 for stain removal, according to a VAS ranging from 1 to 7. Loguercio et al. obtained scores of 3.4 and 2.4 for “improvement of appearance,” using different products for enamel microabrasion. Compatible with previous reports, the results of enamel microabrasion in this case were satisfactory; most of the brown stains were reduced or removed and the porosities due to enamel loss on teeth surfaces eliminated. The appearance of patient was markedly improved without any tooth sensitivity or gingival problems. However, enamel microabrasion followed by the in-office bleaching technique achieved better esthetic improvement by removing nearly all brown stains, harmonizing tooth color and producing a lighter and more homogenous tooth structure.

In previous studies, moderate or severely fluorosed teeth were also treated with combined approaches as were some mild fluorosis cases. In mild fluorosis cases, good results were achieved with enamel microabrasion followed by the in-office bleaching technique. However, there have been inconsistent reports with regard to severe fluorosis cases. Ardu et al. applied enamel microabrasion followed by the home-bleaching technique with enamel reshaping to a patient with severe dental fluorosis and proposed this minimally invasive procedure to treat enamel fluorosis. On the other hand, Ng and Manton reported a severe fluorosis case with dark brown discolorations and enamel defects, in which a combination of microabrasion, in-office and at-home bleaching techniques reduced brown stains; however, further improvement in esthetics was achieved with composite veneers. In the current case study, no enamel reshaping or composite veneers were used, even though the brown stains were more pronounced and enamel defects were larger than those reported in the above-mentioned cases.

In most of the previous reports, the efficacy of treatments was evaluated at the end of the treatment, which does not consider the rebound effect occurring within the following days and weeks. It has been shown that the bleaching process induces enamel alterations ranging from minimal to pronounced depending on the concentration of the gel used, but that this damage is less than that seen after phosphoric acid-etch. After enamel microabrasion, approximately 10-200 µm of the outer enamel layer is removed, depending on the pressure and number of applications, HCl acid concentration and abrasive particles. On the other hand, previous in vitro studies have reported that enamel permeability may
be increased by bleaching treatment, depending on the external bleaching procedure used. Thus, it is important to assess the clinical efficacy of enamel microabrasion or bleaching not only immediately after completion of the treatment, but also after a few months. Ashkenazi and Sarnat reported no staining after 30 months to 4 years follow-up in 5 patients who underwent enamel microabrasion. In the present case, only a slight staining had occurred on treated teeth, which was acceptable for patient, even though, there had been some concerns about the long-term performance of this combined approach, as all teeth were micro-abraded for 10 min and were bleached for 180 min. This result may be attributed to the densely compacted prism-free layer on the enamel surface formed after enamel microabrasion, successful polishing of teeth and application of fluoride gel and CPP-ACP product after in-office bleaching.

CONCLUSIONS

This study reported a clinical case, in which a minimally invasive technique (enamel microabrasion and in-office bleaching) was used for the management of severely fluorosed teeth. Enamel microabrasion improved the appearance of teeth by removing brown stains and enamel porosities while in-office bleaching provided further esthetic improvement by removing residual brown stains and producing a whiter and more homogenous tooth structure. A slight staining was observed at the 2-year follow-up, but the clinical appearance of teeth was acceptable and patient satisfaction was considerably high. The minimally invasive technique including enamel microabrasion and in-office bleaching may be offered as a first treatment option for not only mild or moderate, but also severely fluorosed teeth.

REFERENCES

1. Aoba T, Fejerskov O. Dental fluorosis: Chemistry and biology. Crit Rev Oral Biol Med 2002;13:155-70.
2. Sujak SL, Abdul Kadir R, Dom TN. Esthetic perception and psychosocial impact of developmental enamel defects among Malaysian adolescents. J Oral Sci 2004;46:221-6.
3. Bussadori SK, do Rego MA, da Silva PE, Pinto MM, Pinto AC. Esthetic alternative for fluorosis blemishes with the usage of a dual bleaching system based on hydrogen peroxide at 35%. J Clin Pediatr Dent 2004;28:143-6.
4. Pontes DG, Correa KM, Cohen-Carneiro F. Re-establishing esthetics of fluorosis-stained teeth using enamel microabrasion and dental bleaching techniques. Eur J Esthet Dent 2012;7:130-7.
5. Habbu N, Joshi N, Ramamoothy M, Mabrukar V. Esthetic management of dental fluorosis. Int J Dent Clin 2011;3:80-1.
6. Higashi C, dall’Agno AL, Hirata R, Loguercio AD, Reis A. Association of enamel microabrasion and bleaching: A case report. Gen Dent 2008;56:244-9.
7. Strassler HE. Clinical case report: Treatment of mild-to-moderate fluorosis with a minimally invasive treatment plan. Compend Contin Educ Dent 2010;31:54-8.
8. Price RB, Loney RW, Doyle MG, Moulding MB. An evaluation of a technique to remove stains from teeth using microabrasion. J Am Dent Assoc 2003;134:1066-71.
9. Limeback H, Vieira AP, Lawrence H. Improving esthetically objectionable human enamel fluorosis with a simple microabrasion technique. Eur J Oral Sci 2006;114(Suppl 1):123-6.
10. Al-Jazairy Y. Management of fluorosed teeth using porcelain laminate veneers: A six-year recall case report. Saudi Dent J 2001;13:106-11.
11. Sundfeld RH, Croll TP, Briso AL, de Alexandra RS, Sundfeld Neto D. Considerations about enamel microabrasion after 18 years. Am J Dent 2007;20:67-72.
12. Dean HT. Classification of mottled enamel diagnosis. J Am Dent Assoc 1934;21:1421-6.
13. Train TE, McWhorter AG, Seale NS, Wilson CE, Guo IY. Examination of esthetic improvement and surface alteration following microabrasion in fluorotic human incisors in vivo. Pediatr Dent 1996;18:353-62.
14. Croll T. Enamel Microabrasion. Chicago: Quintessence; 1991. p. 27-60.
15. Ramalho KM, Eduardo Cde P, Rocha RG, Aranha AC. A minimally invasive procedure for esthetic achievement: Enamel microabrasion of fluorosis stains. Gen Dent 2010;58:622-9.
16. Allen K, Agosta C, Estafan D. Using microabrasive material to remove fluorosis stains. J Am Dent Assoc 2004;135:319-23.
17. Welbury RR, Shaw L. A simple technique for removal of mottling, opacities and pigmentation from enamel. Dent Update 1990;17:161-3.
18. Loguercio AD, Correia LD, Zago C, Tagliari D, Neumann E, Gomes OM, et al. Clinical effectiveness of two microabrasion materials for the removal of enamel fluorosis stains. Oper Dent 2007;32:531-8.
19. Bertassoni LE, Martin JM, Torno V, Vieira S, Rached RN, Mazur RF. In-office dental bleaching and enamel microabrasion for fluorosis treatment. J Clin Pediatr Dent 2008;32:185-7.
20. Knösel M, Attin R, Becker K, Attin T. A randomized CIE L*a*b* evaluation of external bleaching therapy effects on fluorotic enamel stains. Quintessence Int 2008;39:391-9.
21. Ardu S, Stavridakis M, Krejci I. A minimally invasive treatment of severe dental fluorosis. Quintessence Int 2007;38:455-8.
22. Ng F, Manton DJ. Aesthetic management of severely fluorosed incisors in an adolescent female. Aust Dent J 2007;52:243-8.
23. Ernst CP, Marroquin BB, Willershausen-Zönnchen B. Effects of hydrogen peroxide-containing bleaching agents on the morphology of human enamel. Quintessence Int 1996;27:53-6.
24. Lopes GC, Bonissoni L, Baratieri LN, Vieira IC, Monteiro S Jr. Effect of bleaching agents on the hardness and morphology of enamel. J Esthet Restor Dent 2002;14:24-30.
25. Schiavoni RJ, Turssi CP, Rodrigues AL Jr, Serra MC, Pécora JD, Fröner IC. Effect of bleaching agents on enamel permeability. Am J Dent 2006;19:313-6.
26. Turssi CP, Schiavoni RJ, Serra MC, Fröner IC. Permeability of enamel following light-activated power bleaching. Gen Dent 2006;54:323-6.
27. Ashkenazi M, Sarnat H. Microabrasion of teeth with discoloration resembling hypomaturation enamel defects: Four-year follow up. J Clin Pediatr Dent 2000;25:29-34.

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