

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

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## ABSTRACT

**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

## 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.<sup>[1]</sup>

Fluorosis staining is commonly considered an esthetic problem because of the psychological impact of unesthetic maxillary or mandibular anterior teeth.<sup>[2]</sup> 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.<sup>[3-5]</sup> 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.<sup>[6,7]</sup>

In the past, enamel microabrasion and vital bleaching were preferred in the treatment of mildly or moderately fluorosed teeth without enamel defects,<sup>[8,9]</sup> while fluorosed teeth with enamel defects were traditionally restored with laminate veneers or crowns.<sup>[5,10]</sup> 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

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the first option, even though the more traditional restorative techniques resulted in satisfactory esthetic appearance in many patients.

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.<sup>[6]</sup> However, teeth exposed to enamel microabrasion can acquire a yellowish or non-homogenous color after treatment since the remaining enamel surface becomes thinner.<sup>[11]</sup> 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.<sup>[3]</sup>

Herein, we report a patient whose severely fluorosed maxillary and mandibular anterior and posterior teeth were improved by a minimally invasive technique including enamel microabrasion followed by in-office bleaching. In addition, the 2-year follow-up is also presented.

## MATERIALS AND METHODS

A healthy 21-year-old woman was referred to the Department of Restorative Dentistry Clinic, Suleyman Demirel University, for treatment of severely fluorosed teeth [Figure 1]. Patient had lived in Isparta since birth, which is a city in Turkey with highly fluoridated drinking water (up to 6 ppm). Intraoral examination resulted in maxillary and mandibular anterior and posterior teeth being scored as “severe” according to the Dean’s Fluorosis Index.<sup>[12]</sup> Initial pantographic radiograph was taken before treatment and vitality test scores of the teeth were recorded using a thermal



**Figure 1:** Baseline image of patient showing maxillary and mandibular teeth, which were scored as “severe” according to the Dean’s Fluorosis Index

sensitivity test. Maxillary canines were missing; thus, first prosthetic treatment options were recommended to patient with or without implant support. However, patient refused to have tooth preparation and could not afford implant restorations at that time. Therefore, we suggested bleaching therapy to manage her fluorosed teeth until implant restorations were performed. Enamel microabrasion followed by in-office bleaching therapy was planned to remove the fluorotic stains and surface porosities and lighten the teeth in order to change the perception of white opaque areas.

### 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™ prophylaxis 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.<sup>[13]</sup> 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

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.

## 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

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.<sup>[14]</sup> 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.<sup>[11]</sup> 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

«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



**Figure 3:** The image of teeth after enamel microabrasion. Most of the brown stains were removed and the porosities due to the enamel loss on teeth surfaces were eliminated



**Figure 4:** The image of teeth after enamel microabrasion and in-office bleaching. with the exception of some residual staining on the approximal surfaces, nearly all brown stains were removed and a better and lighter color and homogenous appearance than after enamel microabrasion alone was evident



**Figure 5:** The image of teeth at the 2-year follow-up. Her extracted canines were restored with prosthetic restorations as were her maxillary right and left lateral incisors, canines, first premolars and left second premolar and first molar at a different dental clinic. A slight staining was observed on the remaining treated teeth, but the clinical appearance of teeth was acceptable

moderate cases.<sup>[9,13,15,16]</sup> A clinical study revealed that this technique removed nearly all brown stains, while the reduction in white stains was 60-100%.<sup>[17]</sup> 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.<sup>[8]</sup> Loguercio *et al.*<sup>[18]</sup> 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.<sup>[4,6,19,20]</sup> In mild fluorosis cases, good results were achieved with enamel microabrasion followed by the in-office bleaching technique.<sup>[4,6,19-22]</sup> However, there have been inconsistent reports with regard to severe fluorosis cases. Ardu *et al.*<sup>[21]</sup> 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<sup>[22]</sup> 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,<sup>[23,24]</sup> but that this damage is less than that seen after phosphoric acid-etch.<sup>[23]</sup> After enamel microabrasion, approximately 10-200  $\mu\text{m}$  of the outer enamel layer is removed, depending on the pressure and number of applications, HCl acid concentration and abrasive particles.<sup>[11]</sup> 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.<sup>[25,26]</sup> 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<sup>[27]</sup> 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.

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