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Clinical Performance of Enamel Microabrasion for Esthetic Management of Stained Dental Fluorosis Teeth

B Divyameena • A Sherwood • S Rathna Piriyanga • G Deepika

Clinical Relevance

Enamel microabrasion is an effective first-line esthetic treatment for the removal of tooth stains due to fluorosis, with an improvement in the appearance of teeth that is associated with a high level of patient acceptance.

SUMMARY

Objective: To assess the immediate postoperative clinical efficacy of an enamel microabrasion procedure for the management of stained dental fluorosis.

Methods and Materials: A total of 103 maxillary and mandibular teeth exhibiting fluorosis from 21 patients assessed according to the Thylstrup-Fejerskov (TF) index were treated using enamel microabrasion. All teeth were subjected to enamel microabrasion using Opalustre (Ultradent Products Inc, South Jordan, UT, USA). Pretreatment and 24-hour posttreatment photographs were taken using a digital single-lens reflex camera. A visual analog scale (VAS) with scores ranging from 1 to 7 was used to assess improvement in appearance and change in brown stains followed by photographic ΔE assessment using the CIEDE2000 formula. Patient satisfaction and tooth sensitivity were recorded on a VAS ranging from 1 to 5. Data were analyzed using parametric and nonparametric tests (α=0.05).

Results: There was a significant difference ($p<0.001$) between the pretreatment appearance/brown stain scores and the posttreatment appearance/change in staining scores. A significant difference ($p<0.05$) was noted in the posttreatment L* and ΔE values, and 80% of patients were satisfied with the treatment. No patients reported sensitivity.

Conclusion: The results of the present study show the efficacy of microabrasion for the esthetic management of stained dental fluoro-

Bommiah. Divyameena, MDS, CSI College of Dental Sciences, Conservative Dentistry and Endodontics, 129, East Veli Street, Madurai, Tamil Nadu 625001, India

*Anand Sherwood, MDS, PhD, CSI College of Dental Sciences, Conservative Dentistry and Endodontics, Madurai, Tamil Nadu, India

Subramani Rathna Piriyanga, MDS, CSI College of Dental Sciences, Conservative Dentistry and Endodontics, Madurai, Tamil Nadu, India

Geeth Deepika, MDS, CSI College of Dental Sciences, Conservative Dentistry and Endodontics, Madurai, Tamil Nadu, India

*Corresponding author: 129 East Veli Street, Madurai, Tamil Nadu 625001, India; e-mail: anand.sherwood@gmail.com

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sis with a high level of patient acceptance and absence of tooth sensitivity. The drawback of microabrasion in the posttreatment result is influenced by the preoperative severity of the initial fluorosis.

INTRODUCTION

Dental fluorosis is a condition of enamel demineralization that is caused by excessive intake of fluoride. It results in white, opaque areas or discolorations ranging from yellow to brown, with or without porosities in the enamel surface.[1] Fluorosis staining of the anterior teeth is an esthetic problem that has been shown to have a psychological impact on the affected individuals.[2] Thus, conservative esthetic management of dental fluorosis not only improves the smiles but also greatly enhances the self-esteem of those afflicted.

The geological crust of India, especially South India, contains fluoride-rich minerals that can contaminate underground drinking water.[3] Tamil Nadu, Madurai, the district from where this article originates, is an endemic fluorosis area that has fluoride levels in drinking water of about 1.5 to 5.0 ppm.[4]

Dental fluorosis stain management is accomplished by three strategies: 1) removing the stained enamel, 2) bleaching the enamel surface, and 3) covering the stained enamel surface.[5] These strategies are done either separately or in combination.

Enamel microabrasion is method of management that removes the outer subsurface enamel as well as the entrapped stains by using a gel with hydrochloric acid.[1] Enamel microabrasion is the suggested first-line treatment for the management of dental fluorosis stains because it, along with stain removal, also improves the surface texture of the enamel surface.[6] Celik and others[1] showed the efficacy of enamel microabrasion in the improvement of appearance in dental fluorosis stains. They also concluded that the efficacy of microabrasion is limited by the severity of the present stains.

With the exception of a few case reports, no studies have been conducted to assess objectively the efficacy of microabrasion for the management of dental fluorosis in India.[7,8] The present study was planned with the primary aim to assess objectively the immediate postoperative efficacy of microabrasion for the management of dental fluorosis. Secondary objectives were to assess the factors influencing the outcome of the treatment, patient satisfaction, and occurrence of tooth sensitivity.

METHODS AND MATERIALS

Approval from the Ethics Committee of the home institution was obtained, and 21 patients consented to participate in the study. A sample size of 100 teeth was calculated to be sufficient to detect the clinical difference in outcome (alpha error = 0.05, power = 95%, effect size = 0.3; G power 3.1.9.2. software, Germany).[9] The patients (and, where appropriate, parents or guardians) were informed about the nature of the treatment, study, and photographs to be taken, and they were asked to sign an informed consent. All stained incisors and canines included in the study were managed by enamel microabrasion.

Patient Selection

A total of 103 teeth of 21 patients (7 males and 14 females) with a mean age of 23.9 ± 6.21 years were included. Maxillary and mandibular incisors and canines of these patients were evaluated using the Thylstrup-Fejerskov (TF) index (Figure 1)[10] by the operator and an experienced, calibrated faculty member. Questionable or normal teeth were not included in the study. The inclusion and exclusion criteria for the study were as follows.

Inclusion criteria:

- Patients who wanted to change the appearance of their stained teeth
- Patients with three or more stained incisors and canines
- Teeth free of caries or restorations
- Patients willing and able to attend periodic follow-up visits

Exclusion criteria:

- Hypersensitive teeth
- Smoking habit
- Poor oral hygiene
- Previous treatment for the stained teeth
- Any history of allergies to dental treatment

Enamel Microabrasion

All maxillary and mandibular incisors and canines with fluorosis stains visible upon smiling, laughing, or speaking were treated in the study. All teeth were photographed initially prior to treatment using a Canon EOS Rebel T6 (Canon, Tokyo, Japan) camera under controlled lighting and at the same distance from the maxillary incisors using a tripod. The same light source, camera, and exposure settings were

TF score	
0	The normal translucency of the glossy creamy-white enamel remains after wiping and drying of the surface
1	Thin white lines are seen running across the tooth surface. Such lines are found on all parts of the surface. The lines correspond to the position of the perikymata. In some cases, a slight 'snowcapping' of the cusps/incisal edges may also be seen
2	The opaque white lines are more pronounced and frequently merge to form small cloudy areas scattered over the whole surface. 'Snowcapping' of the incisal edges and cusp tips is common
3	Merging of the white lines occurs, and cloudy areas of opacity occur spread over many parts of the surface. In between the cloudy areas, white lines can also be seen
4	The entire surface exhibits a marked opacity, or appears chalky white. Parts of the surface exposed to attrition or wear appear to be less affected
5	The entire surface is opaque, and there are round pits (focal loss of the outermost enamel) that are less than 2 mm in diameter
6	The small pits may frequently be seen merging in the opaque enamel to form bands that are less than 2 mm in vertical height. In this class are also included surfaces where cuspal and facial enamel has chipped off, and the vertical dimension of the resulting damage is less than 2 mm
7	There is a loss of the outermost enamel in irregular areas, and less than half the surface is so involved. The remaining intact enamel is opaque
8	The loss of the outermost enamel involves more than half the enamel. The remaining intact enamel is opaque
9	The loss of the major part of the outer enamel results in a change of the anatomical shape of the surface/tooth. A cervical rim of opaque enamel is often noted

Figure 1. *Thylstrup-Fejerskov (TF) index scoring.*

used for posttreatment photos. A focal length of 55mm with flash and auto white balance was used as the camera settings for all photographs. The patient position was adjusted to ensure the maxillary incisors were in the plane of focus. Ambient lighting conditions were difficult to control in the department outpatient environment, and efforts were made to standardize the lighting by excluding daylight and keeping 16 light tubes constant throughout the procedures in the examination room.[11,12] The teeth were kept moist with saliva and water to prevent dehydration during photographic exposures. All clinical procedures, photography, and objective color analysis were performed by the same operator.

Light-cure resin gingival barrier (SDI, Victoria, Australia) was used to protect the gingival tissues. Microabrasion was conducted using Opalustre (Ultradent Products Inc, South Jordan, UT, USA) applied onto the stained areas of the teeth. The microabrasion technique was performed according to the manufacturer's instructions. A fine-grit diamond abrasive bur was used initially for 5 to 10 seconds on the stained areas of the tooth to help the microabrasion slurry penetrate into the enamel. This was followed by drying of the teeth and application of the microabrasion slurry of approximately 1- to 3-mm thickness onto the stained regions of the teeth. The surfaces to which slurry was applied were microabraded using rubber prophy cups (OpalCups, Ultradent Products Inc) attached to a gear reduction handpiece at a speed of approximately 4000 rpm with a slight pressure for 60 seconds. The teeth were rinsed with water between slurry applications. Depending on the stain reduction, microabrasion was repeated up to six times during the same appointment to achieve the desired result. No more than a single syringe of microabrasion slurry was used for any one patient. Enamelast (Ultradent Products Inc), a flavored fluoride varnish sweetened with xylitol, and 5% sodium fluoride in a resin carrier were applied onto the tooth surfaces and left for three minutes. Postoperative photographs were taken 24 hours after the treatment using the same settings from before the treatment (Figure 2). All patients were instructed to use a GC Tooth Mousse (GC Corp, Tokyo, Japan) application twice daily for 20 days according to the manufacturer's instructions.

Subjective Photographic Evaluation

The photographs were evaluated by two independent, calibrated examiners. Five pairs of pre- and posttreatment photographs were randomly selected for determining inter- and intraexaminer reliability. Posttreatment photographs were evaluated for improvement in appearance and change in brown stains using a seven-point visual analog scale (VAS; Table 1). Improvement in appearance was assessed based on the smoothness achieved as compared with the pretreatment stage. Tooth sensitivity and patient satisfaction were assessed using a five-point VAS (Table 1).

Objective Photographic Color Analysis

Objective analysis of photographs was performed by modifying the method described by Bengel.[9,10] Only the maxillary incisors were evaluated, as these were in the plane of focus when the images were acquired. The pre- and posttreatment photographs were

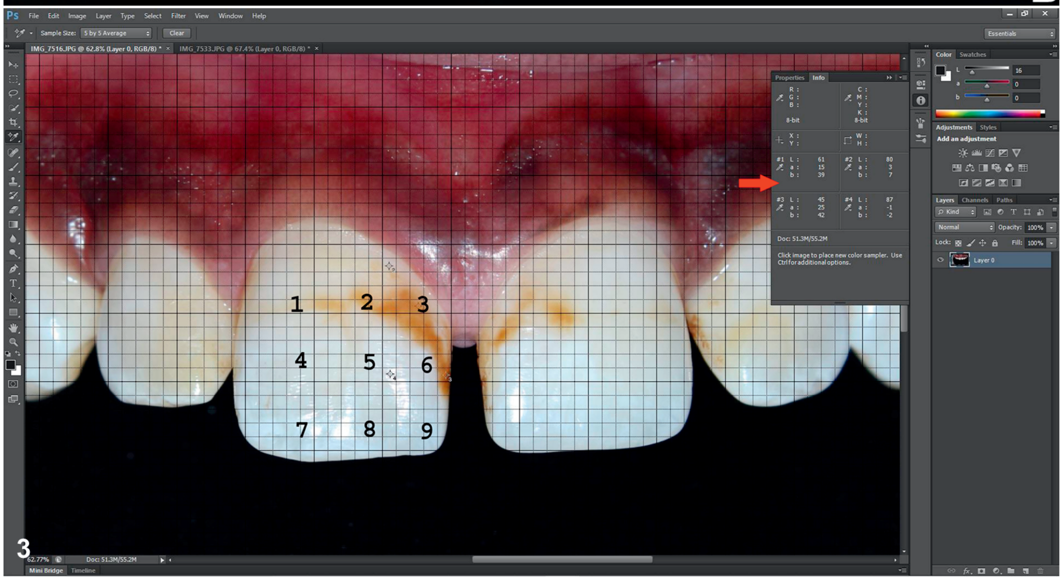

Figure 2. *(A): Pretreatment photograph of fluorosed maxillary incisors TF index=2 and moderate-intensity brown stains. (B): Posttreatment photograph.*

Figure 3. *Screenshot of Adobe Photoshop software showing different stained points marked on the maxillary central incisor. The arrow mark shows the measured L*a*b* values in subdivision 6 of the grid.*

opened in Adobe Photoshop CS5 ("Ctrl + O"; Adobe Inc, San Jose, CA, USA). "View>show>grid" was used to superimpose a grid on the photographs. "Edit>preferences>guides>grids," and "slices>grid line every" were chosen, and values of 70 mm and 5 were input into the "gridline every" and "subdivision," respectively, to change the size of the grid to 70 × 70 mm. This grid size was chosen to enable the maxillary central and lateral incisors to be incorporated into 3 × 3 and 2 × 2 grids, respectively (Figure 3). Each of these grids was numbered from left to right, as shown in Figure 3. The layer panel was made visible by selecting "windows>layers," and the layers were unlocked by double-clicking the lock symbol to the right of the "background." The image was "zoomed in" using the "zoom tool (Z)" to have only the maxillary incisors in the viewing window. All photographs were analyzed using similar settings. To minimize the errors due to different ambient lighting conditions, the photographs were taken with a gray card.[9] From each of the grids in the incisors, two points were selected: 1) most stained and 2) an unstained or least stained in the pretreatment photographs. If a grid did not have any staining or had no difference in stain color, the grid was not used for color measurement. From the "windows" menu, the "info" tab was selected, and the pointer was moved to the selected points to obtain the "x" and "y" coordinates and CIE L*a*b* values. CIE L*a*b* values were calculated using the "color sampler (I)" tool by right-clicking on selected points and choosing the "lab color" option with a dimension of 1 × 1 pixels. To estimate the ΔE values (color difference between most stained and unstained), the points selected in the pretreatment photographs were precisely relocated in the posttreatment images using the reference "x" and "y" coordinates.

The ΔE values were obtained using the CIEDE2000 formula with an online delta E calculator (http://www. colormine.org/delta-e-calculator/Cie2000).

Statistical Analysis

Statistical analyses were performed using SPSS 23.0 (IBM Corp, Armonk, NY, USA). The normality of the data was assessed using the Shapiro-Wilk test, as

Table 1: *Visual Analog Scales*

Pretreatment presenting appearance scores						
1 Highly roughened surface	2 Roughened surface	3	4 Moderately smooth surface	5	6	7 Evenly smooth surface
Pretreatment brown stain scores						
1 Dark intensity	2	3 Moderate intensity	4	5	6 Mild intensity	7 No brown stains
Posttreatment improvement in appearance scores						
1 No improvement	2 Mild improvement	3	4 Moderate improvement	5	6	7 Exceptional improvement
Posttreatment change in brown stain scores						
1 No change	2 Mild change	3	4 Moderate change	5	6	7 Totally removed
Tooth sensitivity scores						
0 No sensitivity	1 Mild sensitivity	2	3 Moderate sensitivity	4	5 Severe sensitivity	
Patient satisfaction scores						
1 Extremely dissatisfied	2 Dissatisfied	3 Neither satisfied or dissatisfied	4 Satisfied	5 Extremely satisfied		

data could not be assumed to be distributed normally. Therefore, improvement in appearance and change in brown stains were tested using the Wilcoxon signed-rank test. The influence of the TF index score and tooth type on the improvement in appearance and change in brown stains was assessed using the Kruskal-Wallis test. The L* color values followed a normal distribution, and differences in L* values were analyzed with a paired *t*-test. The ΔE (color differences) between pre- and posttreatment images was compared using the Wilcoxon signed-rank test. The ΔE differences between the maxillary central and lateral incisors were assessed using the Kruskal-Wallis test. The Freidman test compared the posttreatment ΔE differences between the subdivisions in the grid. For all tests, the probability level for statistical significance was at $\alpha=0.05$.

RESULTS

Subjective Photographic Evaluation

Cohen's kappa statistic values were 0.80 and 0.79, respectively, for inter- and intra-examiner agreement. Table 2 describes the distribution of tooth type; TF index scores; means for presenting appearance, brown stain scores, and improvement in appearance; and change in brown stain scores. There was a significant difference ($p=0.00$; Wilcoxon signed-rank test) between the presenting appearance/brown stain scores and the posttreatment improvement in appearance/change in brown stain scores (Table 2). As the TF index scores increased, there was a significant decrease ($p<0.001$ and 0.007, respectively; Kruskal-Wallis test) in posttreatment improvement in appearance and change in brown stain scores (Table 2). Table 3 details the significant ($p<0.001$; Kruskal-Wallis) difference in posttreatment scores in comparison with the pretreatment scores of presenting appearance and brown stains. With higher pretreatment scores, the posttreatment performance of microabrasion also significantly improved.

Table 4 shows the patient satisfaction scores and sensitivity incidence. Of the patients, 80% (17 patients) were either satisfied or extremely satisfied with the treatment outcome. None of the patients in the present study experienced tooth sensitivity during the procedure. No significant association (Kruskal-Wallis test) was evident between the patient treatment satisfaction and the number of teeth treated, presenting appearance, brown stains, improvement in appearance, or change in stain scores.

Objective Photographic Analysis

Of the total 103 teeth, 78 maxillary central and lateral incisors were assessed for CIE L*a*b* values. Table 5 presents the L* values of the stained points

Table 2: *Distribution of Tooth Type and Visual Analog Scores for Different TF Index Scores*

	TF Index[A]												Total Teeth
	1		2		3		5		6		7		
	Count	Mean ± SD	Count	Mean ± SD	Count	Mean ± SD	Count	Mean ± SD	Count	Mean ± SD	Count	Mean ± SD	
Tooth type													
Maxillary central incisor	18		7		11		1		0		2		20
Maxillary lateral incisor	17		9		8		3		2		0		19
Maxillary canine	9		0		2		5		0		0		20
Mandibular central incisor	1		2		0		0		1		0		19
Mandibular lateral incisor	1		1		0		1		0		1		8
Mandibular canine	1		0		0		0		0		0		9
Total	47		19		21		10		3		3		103
Presenting appearance		5.55 ± 0.73[B]		4.87 ± 0.81[B]		4.79 ± 0.73[B]		4.05 ± 0.50[B]		4.00 ± 1.00[B]		4.17 ± 0.29[B]	
Brown stain score		5.40 ± 0.62[C]		4.89 ± 0.86[C]		5.24 ± 1.22[C]		4.40 ± 0.70[C]		4.17 ± 2.02[C]		4.83 ± 0.76[C]	
Improvement appearance		6.21 ± 0.52[a,b]		6.11 ± 0.68[a,b]		6.21 ± 0.46[a,b]		5.45 ± 0.37[a,b]		5.50 ± 0.50[a,b]		5.17 ± 0.29[a,b]	
Change in brown stains		6.44 ± 0.40[a,c]		6.50 ± 0.44[a,c]		6.43 ± 0.46[a,c]		5.95 ± 0.55[a,c]		5.50 ± 1.00[a,c]		5.67 ± 0.58[a,c]	

Abbreviation: TF index, Thylstrup-Fejerskov index.
[Aa] *Kruskal-Wallis test results showed a significant association (p<0.001 and 0.007, respectively) between the TF index scores and improvement in appearance and change in brown stain scores.*
[BbC,c] *Wilcoxon signed-rank test results showed a significant difference (p<0.001) in scores between presenting appearance, brown stain scores to improvement in appearance, and change in brown stain scores.*

in pre- and posttreatment stages from each subdivision of the grid. Paired *t*-test showed a significant difference ($p<0.05$) between the pre- and posttreatment L* values of the stained areas in all of the subdivisions except for subdivision 8. This subdivision was the least evaluated in the present study (only 9 teeth). The color difference (ΔE) between the stained and unstained areas for pre- and posttreatment stages in each of the subdivisions showed a significant difference ($p<0.05$) using the Wilcoxon signed-rank test (Table 6). Mean pre- and posttreatment ΔE values are depicted in Table 6. Subdivisions 7, 8, and 9 had higher posttreatment ΔE values. Between the maxillary central and lateral incisors, there was no significant difference in ΔE values (Kruskal-Wallis test). The Friedman test did not show any difference in ΔE values between the different subdivisions of the grid for each tooth.

Table 3: *Mean Posttreatment Improvement in Appearance and Brown Stain Scores in Comparison With Pretreatment Scores*

Pretreatment Present Appearance	Posttreatment Improvement in Appearance Scores, Mean ± SD	n
Moderately smooth	5.8284 ± 0.53337[a]	67
Evenly smooth	6.5139 ± 0.40508[a]	36
Brown stains		
Dark intensity	4.5000 ± 0[b]	1
Moderate intensity	6.1917 ± 0.47916[b]	60
Mild intensity	6.5789 ± 0.33944[b]	38
No brown stains	7.0000 ± 0[b]	4

[a] *Kruskal-Wallis test results showed a significant difference (p<0.001) in posttreatment scores in comparison with the pretreatment scores.*
[b] *Kruskal-Wallis test results showed a significant difference (p<0.001) between the posttreatment change in stain score in comparison with pretreatment brown stain score.*

DISCUSSION

In the present investigation, the VAS used was similar to the one used by the Celik group.[1,13] Subjective color evaluations were followed up with objective color change assessment using imaging software (Adobe Photoshop CS5). The TF index scoring criteria were used to classify the fluorosed teeth, as they are based on the histopathological features of the degree of subsurface enamel porosity in dental fluorosis and are more precise in recording the early signs as well as severe grades of fluorosis.[14]

Enamel microabrasion was repeated a maximum of six times per tooth to achieve the desired outcome.

Table 4: *Patient Satisfaction and Tooth Sensitivity Scores*

	Count n	%	Mean
Patient satisfaction			
Dissatisfied	1	4.8	
Neither satisfied or dissatisfied	3	14.3	
Satisfied	13	61.9	
Extremely satisfied	4	19.0	
Patient satisfaction score			3.95
Tooth sensitivity			
No sensitivity	21	100.0	

Table 5: *Mean Pre- and Posttreatment Stained L* Values of Stained Points Analyzed With Paired* t-*test*[a]

	Mean	Minimum	Maximum	SD	*p*-Value (Paired *t*-test)
Pretreatment L*1 a	71.66	46.00	88.00	10.06	
Posttreatment L*1 A	82.70	65.00	94.00	6.55	0.000
Pretreatment L*2 b	75.11	46.00	89.00	10.33	
Posttreatment L*2 B	85.78	67.00	98.00	5.90	0.000
Pretreatment L*3 c	68.43	26.00	90.00	12.80	
Posttreatment L*3 C	81.19	18.54	94.00	11.65	0.000
Pretreatment L*4 d	67.10	21.00	87.00	14.76	
Posttreatment L*4 D	82.55	62.00	97.00	8.24	0.000
Pretreatment L*5 e	81.69	67.00	93.00	7.86	
Posttreatment L*5 E	89.55	80.00	96.00	4.38	0.001
Pretreatment L*6 f	67.81	30.00	84.00	13.43	
Posttreatment L*6 F	83.26	64.00	97.00	7.37	0.013
Pretreatment L*7 g	66.80	41.00	86.00	14.51	
Posttreatment L*7 G	81.40	63.00	97.00	9.30	0.001
Pretreatment L*8 h	76.56	67.00	87.00	6.31	
Posttreatment L*8 h	88.33	81.00	96.00	4.95	0.086
Pretreatment L*9 i	62.67	31.00	85.00	15.25	
Posttreatment L*9 I	76.83	52.00	91.00	11.34	0.001

[a] *A difference in letter case (lowercase vs uppercase) indicates a statistically significant difference, and the same letter case represents no statistically significant difference. Similar letters denote paired* t-*tests performed between these two groups.*

Sundfeld and others showed that microabrasion application for a maximum of five to 10 times results in enamel removal of up to 10 to 200 μm, which is clinically acceptable.[15] Only one syringe of Opalustre was used for each patient, and this was done to observe what level of posttreatment change a single syringe can bring for a patient. None of the patients in the current study required more than one syringe. In agreement with the previous investigation by Celik and others,[1] the results of the current trial show that the posttreatment scores for enamel microabrasion were better when the severity of fluorosis was mild and also when the smoothness of enamel and brown stain scores were less severe. As explained by Celik and others,[1] the brown stains in fluorosed teeth are acquired external stains, and the depth to which these stains have penetrated is amenable to microabrasion removal, as seen in the significant change in posttreatment scores of the present study. Only one patient in the present study had a severe form of fluorosis with loss of enamel surface (TF index score=7). This patient required a composite restoration but was satisfied with the outcome of enamel microabrasion. Patients' acceptance or satisfaction with an esthetic procedure is highly subjective and depends on their social, cultural, and economical background. Nearly 80% of patients in the present study were satisfied with the treatment outcome, and none of the patients opted for any further improvement by any other means. Furthermore, no patients in the present observation reported any tooth sensitivity, supporting the safety of the procedure.

A literature search yielded numerous case reports on the efficacy of microabrasion in fluorosed teeth and recommended this method as an effective and minimally invasive procedure.[16-19] Only very few clinical studies have evaluated the color change achieved with microabrasion in stained fluorosis teeth.[1,13] Adobe Photoshop CD5 software was used for CIE L*a*b* assessment, which is similar to other reports evaluating color change in treated fluorosed teeth.[12,20] Objective color evaluation results revealed that the L* value increased significantly in all areas of the tooth except in subdivision 8. This might be because this subdivision was the least assessed in the present report. On average, the posttreatment L* value of stained points increased by 10 values in all of the areas of the tooth. Pretreatment ΔE values between the stained and unstained points on the tooth were significantly halved after microabrasion mean $\Delta E \leq 3.7$ units is considered to be a clinically acceptable color match in the oral cavity.[21-23] Despite the fact that the postmicroabrasion mean ΔE was >3.7 units for all areas of the teeth assessed, none of the patients in the present report opted for any further intervention. As stated earlier, the esthetic

Table 6: *Pre- and Posttreatment Mean ΔE Values for Maxillary Incisors Assessed in Each Subdivision and Compared With Wilcoxon Signed-Rank Test*[a]

	Tooth Type, Mean ± SD		Mean ± SD	p-Value (Wilcoxon Signed-Rank Test)
	Maxillary central incisor (n=40)	Maxillary Lateral Incisor (n=38)		
Pretreatment ΔE 1 a	12.08 ± 5.59	16.01 ± 8.74	14.24 ± 7.69	0.000
Posttreatment ΔE 1 A	8.45 ± 4.58	8.57 ± 5.02	8.52 ± 4.79	
Pretreatment ΔE 2 b	11.56 ± 6.00	15.72 ± 9.26	13.67 ± 8.04	0.000
Posttreatment ΔE 2 B	6.85 ± 4.23	6.83 ± 3.54	6.84 ± 3.86	
Pretreatment ΔE 3 c	16.91 ± 8.68	22.81 ± 14.56	20.28 ± 12.63	0.000
Posttreatment ΔE 3 C	7.84 ± 4.50	11.36 ± 8.99	9.79 ± 7.49	
Pretreatment ΔE 4 d	22.16 ± 13.79	21.79 ± 14.93	21.98 ± 14.23	0.000
Posttreatment ΔE 4 D	10.22 ± 6.18	9.02 ± 5.84	9.66 ± 6.00	
Pretreatment ΔE 5 e	14.29 ± 10.08	—	14.29 ± 10.08	0.000
Posttreatment ΔE 5 E	7.01 ± 3.98	—	7.01 ± 3.98	
Pretreatment ΔE 6 f	20.54 ± 10.84	—	20.54 ± 10.84	0.000
Posttreatment ΔE 6 F	9.04 ± 6.12	—	9.04 ± 6.12	
Pretreatment ΔE 7 g	26.18 ± 11.62	—	26.18 ± 11.62	0.000
Posttreatment ΔE 7 G	12.40 ± 5.72	—	12.40 ± 5.72	
Pretreatment ΔE 8 h	21.24 ± 11.52	—	21.24 ± 11.52	0.008
Posttreatment ΔE 8 H	11.18 ± 7.48	—	11.18 ± 7.48	
Pretreatment ΔE 9 i	28.12 ± 15.18		28.12 ± 15.18	0.004
Posttreatment ΔE 9 I	15.98 ± 9.96		15.98 ± 9.96	

[a] *A difference in letter case (lowercase vs uppercase) indicates a statistically significant difference; a similar letter case denotes Wilcoxon signed-rank test performed between these two groups.*

acceptance of tooth color is dependent on a patient's social, cultural, and economic background, and the current postmicroabrasion mean ΔE of >3.7 units was acceptable for patients in this study. No direct comparison of the amount of color change was possible, as a literature search indicated no objectively evaluated data following microabrasion in stained fluorosed teeth.[1,13]

The significant improvement in posttreatment appearance and brown stain scores obtained by microabrasion in the present investigation demonstrates the efficacy of this treatment in the esthetic management of stained dental fluorosis. Results of the current study show that even though the performance of enamel microabrasion is limited by the severity of fluorosis, the pretreatment smoothness of the enamel, and the intensity of brown stains, this procedure is an effective first treatment choice to improve esthetics and is a minimally invasive procedure that, when supplemented with other options such as vital-tooth bleaching, can still enhance the success of treatment. To achieve ΔE values <3.7 units, microabrasion procedures should be followed up with bleaching and resin infiltration, as suggested in various case reports.[24-26] The objective evaluation after bleaching and resin infiltration in microabraded teeth should be reported in future studies.

The patients' acceptance of this treatment in the current work shows that in a district such as Madurai, an area with endemic fluorosis, microabrasion can be an economically feasible first-line treatment option compared with other esthetic procedures for the management of stained fluorosed teeth. Clinicians should be informed about the effectiveness and limitations of this procedure for the management of stained fluorosed teeth and also about the patients' perception regarding the treatment outcome.

Long-term follow-up of the patients included in the present study is planned to evaluate the stability of change produced by microabrasion. Furthermore, the authors have requested sponsorship by dental products manufacturers for further treatment of these patients with home bleaching and resin infiltration and objective assessment of the color change following these procedures.

CONCLUSIONS

The results of the present study show the efficacy of microabrasion for the esthetic management of stained dental fluorosis teeth, with a high level of patient acceptance and no tooth sensitivity. Thus, microabrasion, a minimally invasive esthetic procedure, should be the first line of treatment in improving the appearance of the smile in patients with stained fluorosed teeth.

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Regulatory Statement

This study was conducted in accordance with all the provisions of the local human subjects oversight committee guidelines and policies of the CSI College of Dental Sciences. The approval code issued for this study is CSIDSR/12/2018.

Conflict of Interest

The authors of this article certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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