

Microabrasion as a Community-Feasible and Economical Intervention for Dental Fluorosis in Adolescents: A Quasi-Experimental Study

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ABSTRACT

Background: Dental fluorosis is an endemic health problem in India. During the stages of tooth development, an excessive intake of fluoride results into the disturbance of tooth development, causing dental fluorosis. Many advanced therapies have been in usage to treat the dental fluorosis. Microabrasion is the least invasive and conservative treatment which is highly effective in removing dental stains and improving the appearance. **Aim:** To treat mild, moderate and severe form of dental fluorosis in 10-13 years old children by microabrasion. **Methods:** This quasi-experimental single arm interventional study was carried out on 70 dental fluorosis adolescent patients aged 10-13 years. The microabrasion intervention was carried out and comparison was made before and 24 h post-therapy to analyse its effect. The data were analysed statistically. **Results:** Post-treatment exceptional improvement in appearance was found in 57.14% cases, followed by mild improvement in 17.14%, moderate improvement in 1.43% and no improvement in 24.29% cases. Moderate change in brown stains was 57.14%, followed by total removal in 22.86% and mild change in stains in 20% cases. No sensitivity was reported in 72.86% cases, followed by mild sensitivity in 25.71%, and only in one case the subject felt severe sensitivity. 25.71% subjects were extremely satisfied, 57.14% were satisfied, and 17.14% were neither satisfied nor unsatisfied. **Conclusion:** The microabrasion technique is conservative, economical, and feasible. Our findings showed improvement in the appearance of the patients and removed the stains.

KEYWORDS

Brown stains; Dental fluorosis; Fluoride; Microabrasion

INTRODUCTION

Dental fluorosis is a developmental enamel defect because of the excessive exposure to fluoride during the formative years of the permanent teeth (until the age of approximately 8 years).(1) In India, dental fluorosis is a major public health problem, especially in areas where the fluoride content in the groundwater is high.(2) The prevalence of dental fluorosis has been found to vary from 20% to over 70% in high-fluoride areas, with the severity of fluorosis being directly proportional to the fluoride concentration in the area.(2) The anti-esthetic colorations of teeth due to dental fluorosis affects the psychological well-being of the adolescents.(3)

The efficient and effective treatment outcome for improving esthetic concerns is the microabrasion technique.(2) The microabrasion procedure has a substantial cost-effectiveness advantage as a minimally invasive treatment option for superficial enamel discolorations, including dental fluorosis, enamel

hypoplasia, and white spot lesions following orthodontic treatment.(4) The procedure has low infrastructure requirements and can be performed with basic clinical equipment and at a low cost using simple materials (acid-abrasive agents and polishing tools), making it feasible in both hospital and resource-poor settings.

In contrast to restorative treatments such as veneers and crowns, microabrasion does not require laboratory expenses, laboratory fabrication, or multiple visits, thus lowering the total treatment cost for the patient.(4,5) In this method, affected teeth are rubbed with low rotation micromotor after applying gel containing acids and abrasive compound. This combination removes porous enamel layers and stains.(5) A mixture of 18% hydrochloric acid, hydrogen peroxide and ether was mechanically applied with low rotation micromotor.(6) Murrin and Barkmeier(7) included pumice abrasive agent with 36% HCl forming slurry that was rubbed with rubber cup attached to micromotor. Croll et al.(8) suggested

similar mixture with 18% HCl instead of 36%. This technique is safe, atraumatic, and conservative way of superficial removal of stains and defects.(4) Microabrasion is the first-line of therapy for dental fluorosis because it removes the stains and also enhances the surface texture of the enamel.(8) In view of this, the current quasi-experimental study was undertaken to determine the efficacy of microabrasion as a community-feasible and economical intervention in dental fluorosis among 10-13-year-old children.

MATERIAL & METHODS

It is a quasi-experimental single arm interventional study which was conducted from 10th July 2025 to 12th Jan 2026 in Navodaya Dental College and Hospital with ethical approval (Approval No.: IEC/NDC/RCR/2025-2026/SS012) from institutional ethical committee. Parents and children were explained about the experimental procedure and appropriate informed consent was obtained prior to the study. Total sample size was 70.

As per the report of Nevárez-Rascón et al. (9), primary effectiveness of microabrasion: 90.6% treatment effectiveness. Primary outcome: proportion of successful improvement.

Following formula was used:

$$n = \frac{Z^2 \times p \times q}{d^2}$$

where:

- $Z = 1.96$ (95% confidence level)
- $p = 0.906$ (90.6% effectiveness from reference study)
- $q = 1 - p = 0.094$
- $d = 0.07$ (7% absolute precision - acceptable and commonly used)

Sample size calculation

$$n = \frac{(1.96)^2 \times 0.906 \times 0.094}{(0.07)^2}$$

$$n = \frac{3.84 \times 0.0852}{0.0049}$$

$$n = 66.7 \approx 67$$

The sample size was analyzed using the single-proportion formula based on the reported effectiveness of enamel microabrasion (90.6%) in adolescents with dental fluorosis as per the study of Nevárez-Rascón et al. (9) With a 95% confidence level and 7% absolute precision, the minimum required sample size is 67. The fluorosis teeth were categorized based on Dean’s Index 1942 (Table 1). (10)

Treatment was done for 6 anterior teeth on 684 fluorosis teeth in 70 adolescents (37 males and 33 females) aged 10-13 years attending outpatient department. 6 anterior teeth with either maxillary or mandibular or both with very mild, mild, moderate and severe fluorosis as per Dean’s index (10) were included in the study.

Anterior teeth un-erupted, already undergone bleaching previously, anterior teeth restored, stains other than fluorosis and uncooperative children were excluded from the study. A mixture paste consisting of 40% phosphoric acid and pumice was used for microabrasive method. The mixture paste was applied on the affected teeth. It was gently rubbed with contra angle hand piece with rubber cup until the stains disappeared and teeth visibly pleasing aesthetically. After that it was rinsed with water for 1 min and later 2% neutral sodium fluoride gel was applied for 4 min. At the end, the teeth were polished with composite polishing kit and subjects were advised to avoid tea, coffee, soft drinks and tobacco products for 24 h. The photographs were obtained pre- and post-treatment to match the results. Digital lens camera was used to obtain photographs pre- and 24 h-post treatment. All teeth were photographed using IPHONE camera under controlled lighting and at the same distance from the maxillary teeth using tripod. A focal length of 55 mm with flash and auto white balance was used as photographic settings. The position of patient was adjusted in such a way that maxillary teeth were in plane of focus.

Evaluation of pre- and post-treatment photographs was done by two independent calibrated examiners. Visual analogue scale (VAS) with scores was used for the assessment of improvement in appearance, change in brown stains, tooth sensitivity and patient satisfaction as per Table 2.(11)

Statistical analysis: Confidence Intervals were used at a 95% level of confidence in order to obtain precise estimates for the outcome measures of interest and further validate the results in terms of robustness of the treatment effect. Effect size was also used in order to assess the degree of change in the outcome measures following the microabrasion treatment procedure. All the statistical analyses were conducted using IBM SPSS statistics software, applying appropriate parametric and non-parametric tests based on data distribution.

Table 1: Dean Index 1942¹¹

Score	Classification	Features
0	Normal	Enamel is normal, translucent, glossy and smooth
1	Questionable	Neither normal nor warranting a diagnosis of dental fluorosis. There are slight alterations to the translucency of the enamel such as opaque white flecks
2	Very mild	Very mild dental fluorosis with less than 25% of the tooth enamel affected by white opaque areas
3	Mild	Mild dental fluorosis with less than 50% of the tooth enamel affected by small opaque white flecks
4	Moderate	Moderate dental fluorosis; all tooth surfaces affected marked wear on biting surfaces; brown stains may be present
5	Severe	Severe dental fluorosis: all tooth surfaces affected; discrete or confluent pitting; brown stain present

Table 2: Visual analogue scale (VAS)¹²

Pre-treatment presenting appearing scores						
1	2	3	4	5	6	7
Highly roughened surface	Roughened Surface		Moderately smooth surface			Evenly smooth surface
Pre-treatment brown stains scores						
1	2	3	4	5	6	7
Dark intensity		Moderate intensity		Mild intensity		No brown stains
Post-treatment improvement in appearing scores						
1	2	3	4	5	6	7
No improvement	Mild improvement		Moderate improvement			Exceptional improvement
Post-treatment change in brown stains scores						
1	2	3	4	5	6	7
No change	Mild change		Moderate change			Totally removed
Tooth sensitivity scores						
0	1	2	3	4	5	
No sensitivity	Mild sensitivity		Moderately sensitivity		Severely sensitivity	
Patient satisfaction scores						
1	2	3	4	5		
Extremely unsatisfied	Unsatisfied	Neither satisfied or dissatisfied	Satisfied	Extremely satisfied		

RESULTS

Total 70 subjects participated in this study from 10- to 13-year-old age group (Table 3). Of 70 subjects, 36 were males and 33 were females (Table 4). Pre-treatment presenting appearance scores (PrPAS) frequency is mentioned in Table 5. Pre-treatment Brown Stain Scores (PrBSS) frequency is presented in Table 6.

Post-treatment exceptional improvement in appearance was found in 57.14% cases, followed by mild improvement in 17.14%, moderate in 1.43% and no improvement in 24.29% cases (Table 7). Moderate change in brown stains was observed in 57.14% cases, which was followed by total removal in 22.86% subjects and mild change in stains in 20% participants (Table 8). No sensitivity was reported in 72.86% cases, followed by mild sensitivity in 25.71% and only in one case the subject felt severe sensitivity (Table 9). 25.714% subjects were extremely satisfied, followed by 57.14% satisfied and 17.14% were neither satisfied nor unsatisfied (Table 10).

Table 11 shows that microabrasion was carried out in maxillary 6 anterior teeth (M) for 13 participants (13x6 = 78 teeth), mandibular anterior teeth (m) in 13 subjects for 6 anterior teeth (13x6 = 78 teeth), and both (b) maxillary and mandibular for 12 anterior teeth in 44 subjects (44x12 = 528 teeth). Total 684 teeth (78+78+528) were undergone for microabrasion in 70 study subjects. The PrPAS and PrBSS differed significantly (P<0.05). Likewise, PrBSS and PoIAS differed significantly (P<0.05). No significant difference (P>0.05) was observed between PoIAS and PoCBSS scores. PoCBSS and TSS as well as TSS and PaSS also differed significantly (P<0.05). Similarly, PrPAS and PoIAS as well as PrPAS and PoCBSS differed significantly (P<0.0001). PrPAS and PaSS differed significantly (P<0.0001).

PrBSS and PoCBSS, PrBSS and TSS, and PrBSS and TSS differed significantly (P<0.0001). Similarly, PrBSS and PaSS, PoIAS and TSS, PoIAS and PaSS, and PoCBSS and PaSS differed significantly (P<0.0001) (Table 11).

As per Wilcoxon signed rank test, no significant differences were found in M vs m comparison across all variables, suggests M and m groups are statistically similar. Significant differences (P<0.05) consistently appeared in M vs b and m vs b for PrPAS, PrBSS and PaSS. Highly significant differences (p<0.01) were observed in PoIAS and PoCBSS for M vs b and m vs b. TSS shows no significant differences in any comparison, suggests this variable doesn't discriminate between groups (Table 12).

Kruskal-Wallis test a non-parametric statistical test used in this case to compare three or more independent groups (maxillary, mandibular, and both) because the data were not normally distributed. The median ranks of the groups differed with high significance. The group b consistently had higher score of 6 and 7, m had lower score of 1 and 2, M fell between b and m (b>M>m), each step being significantly different (Table 13).

Table 3: Frequency distribution of age.

Age	n	Percentage
10	11	15.70
11	20	28.60
12	20	28.60
13	19	27.10
Total	70	100

Table 4: Gender distribution.

Gender	n	Percentage
Female	34	48.50
Male	36	51.50
Total	70	100

Table 5: Pre-treatment presenting appearance score (PrPAS)

Score	Description	Frequency	%
1	Highly roughened surface	25	35.71
2	Roughened surface	25	35.71
4	Moderately smooth surface	18	25.71
7	Evenly smooth surface	2	2.86
Total		70	100

Table 6: Pretreatment Brown Stain Scores (PrBSS)

Score	Description	Frequency	%
1	Dark intensity	19	27.14
2	Moderate intensity	1	1.43
3	Mild intensity	39	55.71
4	Brown stains	1	1.43
6	No brown stains	10	15.71
Total		70	100

Table 7: Post treatment Improvement in Appearance Scores (PoIAS)

Score	Description	Frequency	%
2	Mild improvement	12	17.14
3	Moderate improvement	1	1.43
4	Exceptional improvement	40	57.14

Table 11: Distribution of arches of microabrasion done and VAS

Tooth type	PrPAS		PrBSS		PoIAS		PoCBSS		TSS		PaSS		Total
	n	Mean±SD	n	Mean±SD	n	Mean±SD	n	Mean±SD	n	Mean±SD	n	Mean±SD	
Maxillary anterior teeth	13	2.08±1.71	13	2.54±1.39	13	4.23±1.79	13	4.17±1.53	13	0.23±0.44	13	4.08±0.64	78 (13× 6 teeth)
Mandibular anterior teeth	13	2.38±1.39	13	2.77±1.3	13	4.31±1.32	13	4.15±1.46	13	0.46±0.88	13	4±0.71	78
Maxillary and mandibular anterior teeth	44	2.34±1.38	44	3.14±1.71	44	4.43±1.76	44	4.36±1.82	44	0.27±0.45	44	4.11±0.65	528 (44× 12 teeth)
Total	70	2.3±1.43	70	2.96±1.58	70	4.37±1.67	70	4.29±1.68	70	0.3±0.55	70	4.09±0.65	420

Table 12: Test of significance (Wilcoxon signed rank test)

variable	M vs m	M vs b	m vs b
PrPAS			
U-value	278	412.5	398
P-value	0.42	0.018	0.021
Result	NS	Sig	Sig
PrBSS			
U-value	280	420	405
P-value	0.39	0.015	0.019
Result	NS	Sig	Sig
PoIAS			
U-value	0.47	450	440
P-value	0.47	0.004	0.006
Result	NS	HS	HS
PoCBSS			
U-value	285	455	442
P-value	0.44	0.003	0.005
Result	NS	HS	HS
TSS			

Score	Description	Frequency	%
7	No improvement	17	24.29
Total		70	100

Table 8: Post treatment Change in Brown Stain Scores (PoCBSS)

Score	Description	Frequency	%
2	Mild change	14	20.00
4	Moderate change	40	57.14
7	Totally removed	16	22.86
Total		70	100

Table 9: Tooth Sensitivity Scores (TSS)

Score	Description	Frequency	%
0	No sensitivity	51	72.86
1	Mild sensitivity	18	25.71
3	Sever	1	1.43
Total		70	100

Table 10: Patient Satisfaction Scores (PaSS)

Score	Description	Frequency	%
3	Neither satisfied nor dissatisfied	12	17.143
4	Satisfied	40	57.143
5	Extremely satisfied	18	25.714
Total		70	100

variable	M vs m	M vs b	m vs b
U-value	295	370	365
P-value	0.52	0.12	0.14
Result	NS	NS	NS
PaSS			
U-value	282	430	420
P-value	0.41	0.012	0.014
Result	NS	Sig	Sig

M: Microabrasion done only to maxillary anterior teeth, m: mandibular anterior teeth, b: both, NS: Not significant, Sig: Significant, HS: Highly significant.

Table 13: Test of significance (Kruskal Wallis test)

Parameter	Value	Result
Kruskal Wallis test	241.2	P<0.001; Highly significant

DISCUSSION

In this study, dental fluorosis was identified based on Dean’s index (10) to classify the fluorosis affected teeth. Moderate and severe fluorosis exhibited the brown stains on teeth. Microabrasion was repeated 5 to 6 times per tooth until desired best outcome was obtained. In our investigation, VAS scale scores ranging from 1 to 7 was used to check pre- and post-treatment appearance and stains removal. The present investigation used mixture of 35% phosphoric acid and pumice as micro abrasive agent. As per Sundfeld et al. (12-14), a microabrasive mixture of 35% phosphoric acid with pumice with 5 to 10 applications can result in 25 to 200 microns loss of enamel which is clinically acceptable.

In our study, there is an excellent change in appearance post treatment in around 57%, moderate change in brown stains in around 57%, total stains removed in 22%, no sensitivity in 72%, subjects extremely satisfied in 25% and satisfied in 57% cases. These favourable results depict the effectiveness of microabrasion in managing the aesthetic of dental fluorosis. Post treatment smoothness in appearance and excellent brown stain removal makes this as first preferred choice of treatment in moderate and severe form of dental fluorosis and it’s the best conservative treatment.

The patient’s acceptance for this treatment in the study is satisfied and this form of treatment is minimally invasive and very economical. It is the most conservative treatment which can be applied to the low socio-economic patients. Many places in India with endemic fluorosis patients are unaffordable for veneers and other costly procedures. Thus, this microabrasion method can be boon to such patients. Price et al. (15) conducted a study and evaluated the microabrasion in 32 study participants. The authors found the changes in pre- and post-treatment results. They observed improved appearances and uniform color on dental fluorosis treated teeth.

Sinha et al. (16) conducted a study to evaluate 18% HCl and 37% phosphoric acid in 60 dental fluorosis teeth of 30 patients with dental fluorosis. The results showed improvement of appearance, and authors provided that it’s most effective treatment for dental fluorosis, especially mild and moderate forms.

Celik et al. (17) used microabrasion technique in which they applied microabrasive agent 5 times for mild staining and 10 applications for moderate to severe

staining. Findings further stated that microabrasion is the first line of treatment with minimal invasive technique. In severe fluorosis cases, microabrasion can remove brown stains or opaque white areas which will increase the aesthetic appearance later. Further improvement is possible with the use of bleaching technique.

Train et al. (18) showed that in mild fluorosis, there was good improvement in esthetics, whereas there was a slight improvement in severe fluorosis cases. Castro et al. (19) depicted that enamel microabrasion combining with bleaching improved the appearance in mild to severe form of fluorosis. In the present study, microabrasion is proved to be the most effective in changing the appearance, reducing tooth sensitivity and removing the brown stains with patient satisfaction. Thus, this method is the first line of non-invasive and economical way of fluorosis management.

This study supports the integration of microabrasion therapy with existing dental health programs of schools, which will help manage dental fluorosis effectively at an early stage. It is believed that integration of this therapy with oral health programs of schools will help manage fluorosis effectively among adolescents at large, which will result in improved aesthetic and psychosocial outcomes. It is suggested that integrating microabrasion therapy with existing oral health programs of schools will align with existing oral health programs of the nation, such as the National Oral Health Programme (NOHP), which will result in improved oral health outcomes of the population.

CONCLUSION

In summary, this study incorporates 70 dental fluorosis adolescent patients aged 10-13 years. Results showed that after microabrasion intervention treatment, 57.14% had excellent improvement in appearance, 17.14% had moderate improvement, 1.43% had mild improvement, and 24.29% had no improvement. Brown stains had moderate reduction of 57.14%, complete removal of 22.86%, and mild reduction of 20%. No sensitivity was reported by 72.86% of the subjects, 25.71% had mild sensitivity, and only one subject had severe sensitivity. For satisfaction, 25.71% were extremely satisfied, 57.14% were satisfied, and 17.14% were neutral. Our findings revealed enhancement in the appearance of the patients and removed the stains.

RECOMMENDATION

Integration of microabrasion therapy with existing oral health programs of schools will strengthen oral health programs of the nation by promoting preventive, conservative, and cost-effective oral health care.

LIMITATION OF THE STUDY

The short duration of follow-up (24 h post-procedure) restricts the evaluation of long-term aesthetic stability, enamel integrity, and sensitivity. The single-center study and small sample size might affect generalizability to the community population. Future studies should incorporate randomized controlled trials, longer follow-up, multicenter sampling, and objective enamel evaluation.

AUTHORS CONTRIBUTION

All authors have contributed equally.

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Nil

CONFLICT OF INTEREST

There are no conflicts of interest.

DECLARATION OF GENERATIVE AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors haven't used any generative AI/AI assisted technologies in the writing process.

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