Khalij Libya Journal of Dental and Medical Research. 2026;10(2):204-212
https://doi.org/10.47705/kjdmr.26303
eISSN:2708-888X

Original article

Management of Mild to Moderate Dental Fluorosis Using Enamel Microabrasion and Bleaching Techniques

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Abstract

Dental fluorosis is a developmental enamel defect that may result in esthetic concerns, particularly in mild and moderate cases. Conservative treatment modalities, including enamel microabrasion and bleaching, have gained increasing attention because of their ability to improve appearance while preserving tooth structure. The purpose of this narrative review was to evaluate the current evidence regarding the effectiveness of enamel microabrasion and bleaching in the management of mild to moderate dental fluorosis and to discuss their clinical applications, limitations, and future research needs. Previous studies have demonstrated that enamel microabrasion is an effective minimally invasive approach for superficial fluorosis stains, especially in mild cases. However, its effectiveness decreases with increasing lesion depth and severity. Comparative clinical studies indicate that bleaching procedures and combination protocols involving enamel microabrasion followed by bleaching generally provide superior esthetic outcomes and greater patient satisfaction than enamel microabrasion alone. Combination therapy appears to benefit from the complementary mechanisms of both procedures, resulting in improved color uniformity and more predictable outcomes. Despite encouraging clinical results, the available evidence remains limited by small sample sizes, methodological heterogeneity, short follow-up periods, and inconsistent outcome assessment methods. In addition, long-term randomized clinical trials and standardized treatment protocols are still lacking. Overall, minimally invasive conservative approaches represent effective options for the management of mild to moderate dental fluorosis. Treatment selection should be individualized according to lesion severity and patient expectations. Further high-quality studies are needed to establish evidence-based guidelines and optimize long-term treatment outcomes.

Keywords: Dental fluorosis, Enamel microabrasion, Dental bleaching, Conservative treatment, Minimally invasive dentistry.

Received: 30/04/26
Accepted: 28/06/26
Published: 06/07/26

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Introduction

Dental fluorosis is a condition affecting the enamel due to chronic ingestion of high concentrations of fluoride during tooth development, resulting in color changes ranging from mild white spots to light brown stains [1,2]. The prevalence of dental fluorosis varies considerably among populations and is particularly higher in endemic regions where drinking water contains naturally elevated fluoride levels. In addition, increased exposure has been associated with the widespread and sometimes unsupervised use of fluoride-containing dental products, including toothpastes and mouth rinses [3]Although mild and moderate forms of fluorosis do not typically compromise tooth function, they may have a significant negative impact on dental aesthetics and, consequently, on patients' psychosocial well-being, particularly when anterior teeth are affected [4].

For diagnostic and clinical decision-making purposes, several classification systems have been developed. Among them, Dean's Index which remains one of the most widely used tools for categorizing fluorosis severity into mild, moderate, and severe forms. This review is limited to mild and moderate fluorosis cases, which are the most amenable to minimally invasive esthetic management. In contemporary dentistry, there is a strong emphasis on preserving healthy tooth structure, which has led to a shift toward minimally invasive management strategies for esthetic improvement of mottled enamel, including enamel microabrasion, tooth bleaching, and, more recently, resin infiltration.

Enamel microabrasion is a conservative technique that combines mechanical abrasion with acidic agents to remove a superficial layer of enamel, thereby reducing or eliminating superficial discolorations and improving surface smoothness [5], [6]. Tooth bleaching, using agents such as hydrogen peroxide, carbamide peroxide, or McInnes aims to improve overall tooth color by oxidizing chromogenic compounds within the enamel and dentin structure [7].

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eISSN:2708-888X

Although additional minimally invasive techniques such as resin infiltration have been introduced, their cost and limited availability may restrict their use in certain clinical settings. Consequently, there is growing interest in conservative and accessible approaches for managing dental fluorosis, particularly enamel microabrasion alone or in combination with bleaching. However, the current body of evidence remains heterogeneous, and the comparative effectiveness of these approaches has not been fully established. Therefore, this narrative review aims to critically evaluate the available evidence regarding the effectiveness of enamel microabrasion alone and in combination with bleaching in the management of mild to moderate dental fluorosis, with the goal of assisting clinicians in selecting predictable and minimally invasive treatment strategies that preserve enamel structure while optimizing esthetic outcomes.

Methods

This narrative literature review was conducted to summarize and critically appraise the available evidence on the conservative management of mild to moderate dental fluorosis using enamel microabrasion alone or in combination with bleaching. A comprehensive search of the literature was performed in April 2026 using PubMed, Scopus, and Google Scholar databases. Studies published in English that addressed minimally invasive treatment modalities for dental fluorosis were considered. No restriction was applied regarding the year of publication in order to capture the full scope of relevant evidence.

The selection process involved an initial screening of titles and abstracts to identify potentially relevant studies, followed by full-text evaluation of eligible open access articles. Data from the included studies were extracted and organized according to study design, type of intervention, and reported clinical outcomes.

The search strategy was based on the following keywords: “dental fluorosis,” “enamel microabrasion,” “bleaching,” and “combination therapy.” Eligible study designs included clinical trials, case reports, case series, and review articles that provided relevant clinical or therapeutic information. Studies focusing exclusively on severe fluorosis, invasive restorative procedures, or resin infiltration as a standalone approach were excluded when not directly aligned with the objectives of this review.

Previous Studies

The reviewed studies included clinical trials, case reports, case series, and systematic reviews, that evaluated the use of enamel microabrasion, bleaching, and combined treatment approaches for mild to moderate dental fluorosis. To make the findings easier to present and compare, the studies were grouped according to the main treatment method, including enamel microabrasion, bleaching, combination therapy, and research gaps. A summary of the included studies is presented in Table 1.

1. Evidence Supporting Enamel microabrasion

Enamel microabrasion is a conservative and minimally invasive treatment used to improve superficial enamel defects caused by dental fluorosis. Many studies have reported that it is an effective esthetic treatment for mild fluorosis, especially when the discoloration is limited to the outer enamel layer [6]; [15]; [16]. Because only a small amount of enamel is removed, the procedure helps preserve tooth structure and is widely used in clinical practice. The effectiveness of enamel microabrasion depends mainly on the severity of fluorosis and the depth of the enamel defect. It works well in mild cases with superficial stains, but its ability to improve appearance decreases in moderate cases or when the discoloration extends deeper into the enamel. In these situations, white or brown stains may remain visible after treatment [12,17]

Several studies have compared enamel microabrasion with bleaching. In a split-mouth clinical study involving 30 children with mild to moderate fluorosis, both enamel microabrasion and McInnes bleaching improved tooth appearance. However, bleaching produced better esthetic results immediately after treatment and at the six-month follow-up. Postoperative sensitivity was mild and temporary in both groups [10]Likewise, a systematic review which included five randomized clinical trials involving 304 patients, found that enamel microabrasion produced less esthetic improvement than bleaching alone [14]. Another factor that affects treatment success is the amount of enamel removed during enamel microabrasion. Previous studies reported that enamel loss usually ranges from 25 to 200 µm. This limited enamel removal explains why the technique is considered conservative, but it also explains why deep enamel defects cannot always be completely eliminated [16] [18]. Therefore, enamel microabrasion is most suitable for mild fluorosis with superficial enamel defects, while deeper lesions may require additional treatment.

2. Evidence Supporting Bleaching

Bleaching is a well-established conservative treatment for improving the esthetic appearance of teeth affected by mild to moderate dental fluorosis. Unlike enamel microabrasion, which removes a thin superficial layer of enamel, bleaching lightens intrinsic discoloration by oxidizing chromogenic pigments within the enamel. This mechanism enhances overall tooth color while preserving enamel structure. Several clinical studies have shown that bleaching is particularly effective in

reducing generalized yellow and brown discoloration and improving color uniformity, making it an important minimally invasive treatment option [13]; [11]
Comparative studies suggest that bleaching may provide greater esthetic improvement than enamel microabrasion in selected fluorosis cases. In a split-mouth clinical study, the investigator reported that both enamel microabrasion and McInnes bleaching significantly improved tooth appearance; however, bleaching produced better esthetic results immediately after treatment and at the six-month follow-up. Likewise, in a systematic review of five randomized clinical trials involving 304 patients, concluded that bleaching generally resulted in greater esthetic improvement and higher patient satisfaction than enamel microabrasion alone. Nevertheless, treatment outcomes remained influenced by lesion severity and the extent of enamel involvement.[10,14]
Although bleaching offers favorable esthetic outcomes, it also has limitations. It effectively improves intrinsic discoloration but cannot eliminate enamel surface defects, white opaque lesions, or pitting associated with fluorosis. For this reason, several authors have suggested that bleaching alone may not be sufficient for all patients, particularly when structural enamel defects are present. In such cases, treatment should be selected according to lesion depth, fluorosis severity, and the patient's esthetic expectations. [8]

3. Evidence Supporting Combination Therapy
Recent evidence has increasingly supported the use of combination therapy for the management of mild to moderate dental fluorosis. While enamel microabrasion effectively removes superficial enamel defects, residual discoloration may remain, especially in moderate cases. Adding bleaching after enamel microabrasion can improve overall tooth color, reduce the contrast of remaining stains, and produce a more uniform esthetic appearance [12]; [15]. The systematic review further supported this approach, reporting that enamel microabrasion followed by at-home bleaching resulted in greater esthetic improvement and higher patient satisfaction than enamel microabrasion alone. However, one of the included studies did not demonstrate a statistically significant additional benefit, suggesting that the effectiveness of combination therapy may vary according to clinical conditions and lesion characteristics.[14]
Clinical reports also support this treatment approach. The combination of enamel microabrasion and 35% hydrogen peroxide bleaching was reported to be an effective and conservative technique. [13] The favorable esthetic outcomes were also reported following enamel microabrasion combined with home bleaching using10% carbamide peroxide.[11] More recent evidence showed that combination protocols improved color uniformity and overall esthetic appearance, and highlighted the value of adjunctive bleaching in enhancing final treatment outcomes [3]. The rationale behind combination therapy lies in the complementary effects of both procedures. Enamel microabrasion removes superficial stains and enamel irregularities, whereas bleaching improves intrinsic tooth color and minimizes the visibility of remaining defects. As a result, combined treatment often provides more predictable esthetic outcomes and greater patient satisfaction than either technique alone.

4. Adverse Effects and Clinical Limitations
The available evidence indicates that both enamel microabrasion and bleaching are safe and conservative treatment options for mild to moderate dental fluorosis when performed according to recommended clinical protocols. Most reported adverse effects were mild, temporary, and resolved without additional treatment. For enamel microabrasion, transient postoperative tooth sensitivity was the most commonly reported complication. Enamel reduction may also increase the visibility of the underlying dentin, resulting in a slight yellowish appearance in some patients. In addition, enamel microabrasion may not completely remove deep white opacities, brown stains, or surface irregularities, particularly in moderate fluorosis cases [10]; [12]
Bleaching was likewise associated with minimal adverse effects, with temporary tooth sensitivity reported most frequently. However, bleaching improves tooth color without correcting structural enamel defects or pitting. Therefore, it may not provide satisfactory results when used as a standalone treatment in patients with more pronounced enamel changes. Overall, the reviewed studies indicate that both techniques have favorable safety profiles. Their individual limitations explain why many clinicians prefer combination therapy, particularly for moderate fluorosis, where a single treatment may not achieve the desired esthetic outcome [8,11]

5. Research Gaps and Limitations of Current Evidence
The main limitations of the available evidence and future research priorities are summarized in Table 2. Although the reviewed studies reported encouraging clinical outcomes, the current evidence remains limited by several methodological weaknesses. Most published reports consist of case reports, case series, or single-center clinical investigations with relatively small sample sizes [3,9] In addition, well-designed randomized controlled trials directly comparing enamel microabrasion and bleaching remain limited.

Khalij Libya Journal of Dental and Medical Research. 2026;10(2):204-212
https://doi.org/10.47705/kjdmr.26303
eISSN:*2708-888X*

Another challenge is the lack of consistency in outcome assessment. Different studies evaluated treatment success using blinded photographic assessment, spectrophotometric color measurements, patient satisfaction questionnaires, or oral health-related quality-of-life indices. This variation makes direct comparison of results difficult and reduces the overall strength of the available evidence [9,19] Treatment outcomes are also influenced by lesion severity and enamel defect depth. However, these factors have not been standardized across the reviewed studies, making it difficult to identify which patients are most likely to benefit from enamel microabrasion alone and which require combination therapy [16]. Moreover, several reports supporting combined treatment protocols were based on case reports or case series without control groups, limiting their ability to demonstrate clear comparative superiority [3,20]
Another important limitation is the relatively short follow-up period in most clinical studies, which generally ranged from six to nine months. As a result, evidence regarding the long-term stability of treatment outcomes and the possibility of relapse after bleaching remains limited [9].Patient-centered outcomes and comprehensive reporting of adverse effects have also received less attention than esthetic outcomes. Overall, the current evidence highlights the need for larger randomized clinical trials with longer follow-up periods, standardized outcome measures, and consistent classification of fluorosis severity. Such studies would provide stronger evidence for developing reliable clinical guidelines for the conservative management of mild to moderate dental fluorosis.

Table 1: Characteristics of reviewed studies.

Author	Year	Study Design	Sample Size	Intervention	Main Findings
Sherwood, Baskar, Bommiah, Edwin, Kanesalingavelan, Boominathan	2024	Clinical trial	27 patients	Enamel microabrasion + home bleaching + resin infiltration	Mean ΔE fell from 7 to 4.5 after bleaching and to 3.008 after resin infiltration, supporting the three-step minimally invasive approach [8]
Ghanem, Elezz, Ghoniem, Koneski, Ghoniem	2023	In vivo comparative study	4 patients	Power bleaching; enamel microabrasion + bleaching; bleaching + resin infiltration; enamel microabrasion + bleaching + resin infiltration	All modalities improved color, but resin infiltration-containing approaches produced the greatest color change and better color stability, while bleaching alone had the lowest change [9]
Bharath, Reddy, Poornima, Revathy, Kambalimath, Karthik	2014	Split-mouth clinical study	30 children	Enamel microabrasion vs McInnes bleaching	McInnes bleaching produced better immediate and 6-month esthetic improvement than enamel microabrasion; postoperative sensitivity was negligible and transient [10]
Wang, Meng, Meng	2020	Case report	1 patient	Enamel microabrasion + 2 weeks at-home bleaching + resin infiltration	Moderate fluorosis was successfully treated, with satisfactory esthetics maintained at 2 years [3]
Sundfeld, Pavani, Pini, Machado, Schott, Bertoz, Sundfeld	2019	Clinical case report	1 patient	Enamel microabrasion + home-monitored bleaching with 10% carbamide peroxide	Teeth were bleached effectively over 23 days, and the patient reported satisfaction; the combined approach was described as an excellent treatment [11]
Sundfeld, Sundfeld-Neto, Machado, Franco, Fagundes, Briso	2014	Case series	3 patients	Enamel microabrasion	Enamel microabrasion resolved superficial enamel irregularities and intrinsic stains in selected cases, with follow-up reported at 11, 20, and 23 years [6]
Balan, Uthaiah, Narayanan, Monnappa	2013	Case report	1 patient	Enamel microabrasion with 18% HCl and pumice slurry	Enamel microabrasion was reported as a safe and efficient minimally invasive method for removing fluorosis stains and improving appearance [12]

Bertassoni, Martin, Torno, Rached, Vieira, Mazur	2008	Case report	1 patient	In-office bleaching with 35% hydrogen peroxide + enamel microabrasion	The combined conservative approach was effective for restoring esthetics in fluorosis-affected teeth [13]
Shahroom, Mani, Ramakrishnan	2019	Systematic review of randomized controlled trials	304 patients	Enamel microabrasion, bleaching, resin infiltration, and combinations	Across included trials, enamel microabrasion showed less esthetic improvement than bleaching, while resin infiltration and resin infiltration plus bleaching showed greater esthetic improvement [14]

Table 2: Research Gaps and Future Research Needs

Research Gap	Evidence from Included Studies	Potential Impact	Future Research Need
Small sample sizes	one included only 4 patients; several studies were case reports or case series	Limited generalizability of findings	Larger multicenter clinical trials
Short follow-up periods	Most studies reported follow-up of 6–9 months; long-term stability remains unclear	Uncertainty regarding durability of outcomes	Long-term follow-up studies >2 years
Lack of standardized outcome measures	Studies used photographs, spectrophotometry, satisfaction scores, and OHIP* measures	Difficult comparison between studies	Development of standardized outcome assessment tools
Limited high-level evidence	Most available evidence consists of case reports, case series, and few RCTs**	Weak evidence for clinical recommendations	More randomized controlled trials
Inadequate severity stratification	Lesion depth and fluorosis severity were inconsistently classified	Difficulty identifying optimal treatment for different cases	Standardized fluorosis severity grading systems
Limited patient-centered outcomes	Few studies assessed quality of life or patient satisfaction comprehensively	Clinical success may not reflect patient perception	Greater incorporation of PROMs*** and QoL**** measures

*Oral Health Impact Profile(OHIP). ** Randomized Clinical Trials (RCTs). ***Patient-Reported Outcome Measures (PROMs). ****Quality of Life (QoL)*

Table 3: Comparison of Treatment Modalities

Treatment Modality	Advantages	Limitations	Clinical Indications
Enamel microabrasion	Conservative, preserves enamel	Less effective for deep defects	Mild superficial fluorosis
Bleaching	Improves overall tooth color	Possible sensitivity	Generalized discoloratio n

Khalij Libya Journal of Dental and Medical Research. 2026;10(2):204-212
https://doi.org/10.47705/kjdmr.26303
eISSN:2708-888X

Enamel microabrasion + Bleaching	Better esthetic outcomes and satisfaction	Requires multiple treatment steps	Mild to moderate fluorosis
Combination with Resin Infiltration	Masks residual opacities	Limited evidence	Persistent white opacities

Discussion

The management of mild to moderate dental fluorosis has shifted toward minimally invasive treatment approaches that aim to improve esthetics while preserving healthy tooth structure. Instead of relying on restorative procedures that require irreversible enamel removal, current treatment strategies focus on selecting the least invasive technique capable of achieving satisfactory esthetic outcomes. As shown in Table 3, each treatment modality has specific advantages, limitations, and clinical indications. Therefore, successful management depends primarily on lesion depth, fluorosis severity, and individual patient expectations rather than on the use of a single treatment approach.

Enamel microabrasion remains an important conservative treatment because it selectively removes superficial enamel defects while preserving most of the tooth structure. The reviewed studies consistently demonstrated favorable outcomes in mild fluorosis, particularly when discoloration was confined to the outer enamel layer. This finding is consistent with the mechanism of enamel microabrasion which removes only a thin superficial layer. Consequently, the procedure becomes less effective as lesion depth increases. This explains why complete stain removal is not always achieved in moderate fluorosis. Therefore, careful assessment of lesion depth is an essential step before selecting enamel microabrasion as the treatment. Also, incomplete stain removal should not necessarily be considered a treatment failure but rather a reflection of the biological limitations of the procedure.

Bleaching contributes differently to fluorosis management by improving intrinsic tooth color instead of removing enamel defects. This difference in mechanism may explain why several comparative studies reported superior esthetic outcomes with bleaching. Nevertheless, the reviewed studies used different bleaching agents, concentrations, application times, and treatment protocols. Therefore, the improved esthetic outcomes observed with bleaching cannot be attributed purely to the bleaching procedure itself. Variations in bleaching materials and clinical protocols may also have influenced treatment effectiveness, highlighting the need for standardized protocols in future clinical studies.

The favorable outcomes associated with combination therapy can be explained by the complementary mechanisms of the individual procedures. Enamel microabrasion removes superficial defects, bleaching improves intrinsic tooth color, and reduces residual discoloration. This sequential approach allows each procedure to compensate for limitations of the other. Interestingly, most of the reviewed studies performed enamel microabrasion before bleaching, which suggested that removal of the outer layer may enhance the subsequent bleaching effect. However, the available evidence does not clearly determine whether treatment success is influenced primarily by the sequence of procedures, the concentration of the materials, or by bleaching itself. Further comparative studies are needed to clarify this issue.

Another important clinical implication is that no single treatment protocol is appropriate for every patient. Treatment selection should be based on lesion severity, depth of discoloration, enamel pitting, patient expectations, and esthetic demands. Mild superficial lesions often respond well to enamel microabrasion alone, whereas moderate fluorosis frequently benefits from adjunctive bleaching and, in selected situations, resin infiltration. Restorative treatment should be reserved for severe cases with extensive enamel loss or structural defects that cannot be managed conservatively.

Long-term esthetic stability remains one of the least investigated aspects of conservative fluorosis management. Although several studies reported satisfactory short-term outcomes, most follow-up periods were limited to six or nine months. Therefore, it is still uncertain whether long-term color stability is influenced mainly by the bleaching agent, treatment sequence, lesion characteristics, or the combination of these factors. Additional well designed long-term randomized clinical trials are needed to clarify these relationships and identify the most predictable treatment protocols

Although conservative treatment approaches have demonstrated encouraging clinical outcomes, the available evidence should be interpreted cautiously. Most published studies consist of case reports, case series, retrospective investigations, or relatively small clinical trials. In addition, differences in treatment protocols and outcome assessment methods limit direct comparison among studies. Future research should therefore focus on standardized severity classification, objective esthetic outcome measures, patient-reported outcomes, and longer follow-up periods to strengthen and establish evidence-based clinical guidelines.

Khalij Libya Journal of Dental and Medical Research. 2026;10(2):204-212
https://doi.org/10.47705/kjdmr.26303
eISSN:2708-888X

Overall, the available evidence supports conservative management as the preferred approach for mild to moderate dental fluorosis. The successful management ultimately depends on accurate assessment of lesion characteristics and good selections of the most appropriate conservative treatment for individual patient.

Clinical Implications and Recommendations

The findings of this review have important clinical implications for the conservative management of mild to moderate dental fluorosis. Enamel microabrasion remains a predictable and minimally invasive treatment option for superficial enamel defects, particularly when discoloration is confined to the outer enamel layer. Its ability to preserve enamel structure, together with its favorable safety profile, supports its use as a first-line treatment in appropriately selected cases. Treatment selection, however, should be individualized according to lesion depth, fluorosis severity, and the patient's esthetic expectations. While enamel microabrasion alone may provide satisfactory results in mild fluorosis, moderate cases and deeper intrinsic discoloration often benefit from adjunctive bleaching to improve color uniformity and overall esthetic appearance. The reviewed evidence also suggests that combination therapy frequently provides more predictable outcomes than either technique alone. Clinicians should recognize the limitations of conservative treatment. Deep stains, enamel pitting, and extensive structural defects may not respond adequately to enamel microabrasion or bleaching alone. In these situations, additional minimally invasive procedures, such as resin infiltration, or restorative treatment may be considered when appropriate.

According to the available evidence, careful case selection remains the most important factor for successful treatment. Conservative approaches should always be considered before restorative procedures, and treatment protocols should be tailored to the clinical presentation rather than applying the same approach to every patient. Long-term follow-up is also recommended to evaluate the stability of esthetic outcomes and patient satisfaction.

Conclusion

Enamel microabrasion is an effective and conservative treatment modality for managing superficial lesions associated with mild dental fluorosis. Nevertheless, its effectiveness decreases with increasing lesion depth and severity. Current evidence suggests that combination protocols involving enamel microabrasion and bleaching generally provide superior esthetic outcomes and greater patient satisfaction compared with enamel microabrasion alone, particularly in moderate fluorosis cases. The success of treatment depends largely on lesion characteristics and should be guided by individualized clinical assessment. Although the available evidence supports minimally invasive approaches, limitations related to study design, small sample sizes, short follow-up periods, and heterogeneity of outcome measures restrict the strength of current recommendations. Further well-designed randomized clinical trials with standardized protocols and longer follow-up periods are required to establish evidence-based guidelines for the conservative management of mild to moderate dental fluorosis

Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

References

1- Buzalaf MAR. Review of Fluoride Intake and Appropriateness of Current Guidelines. Adv Dent Res. 2018;292:157–66. doi:10.1177/0022034517750850
2- Aoba T, Fejerskov O. Dental fluorosis: Chemistry and biology. Crit Rev Oral Biol Med. 2002;132:155–70. doi:10.1177/154411130201300206
3- Wang Q, Meng Q, Meng J. Minimally invasive esthetic management of dental fluorosis: a case report. J Int Med Res. 2020;4810:0300060520967538. doi:10.1177/0300060520967538
4- Den Besten PK. Mechanism and timing of fluoride effects on developing enamel. J Public Health Dent. 1999;594:247–51. doi:10.1111/j.1752-7325.1999.tb03277.x
5- Pini NIP. Enamel microabrasion: An overview of clinical and scientific considerations. World J Clin Cases. 2015;31:34. doi:10.12998/wjcc.v3.i1.34
6- Sundfeld RH, Sundfeld-Neto D, Machado LS, Franco LM, Fagundes TC, Briso ALF. Microabrasion in tooth enamel discoloration defects: three cases with long-term follow-ups. J Appl Oral Sci. 2014;224:347–54. doi:10.1590/1678-775720130672
7- Joiner A. The bleaching of teeth: A review of the literature. J Dent. 2006;347:412–9. doi:10.1016/j.jdent.2006.02.002
8- Sherwood D, Baskar R, Bommiah D, Edwin MG, Kanesalingavelan S, Boominathan SK. Clinical performance of combined microabrasion, home bleaching and resin infiltration for the esthetic management of stained fluorotic teeth. J Oper Dent Endod. 2024;81:5–10. doi:10.5005/jp-journals-10047-0130
9- Ghanem O, Elezz AFA, Ghoniem AF. Effect of combining minimal invasive modalities on treating mild dental fluorosis: An in vivo study. Open Access Maced J Med Sci. 2023;11D:44–9. doi:10.3889/oamjms.2023.11436

10- Bharath K, Subba Reddy V, Poornima P, Revathy V, Kambalimath H, Karthik B. Comparison of relative efficacy of two techniques of enamel stain removal on fluorosed teeth. An in vivo study. J Clin Pediatr Dent. 2014;383:207–14. doi:10.17796/jcpd.38.3.0h120nkl8852p568

11- Sundfeld D, Pavani C, Pavesi Pini N, Machado L, Schott T, Bertoz ADM, et al. Esthetic recovery of teeth presenting fluorotic enamel stains using enamel microabrasion and home-monitored dental bleaching. J Conserv Dent. 2019;224:401. doi:10.4103/JCD.JCD_77_19

12- Balan B, Madanda Uthaiah C, Narayanan S, Mookalamada Monnappa P. Microabrasion: An effective method for improvement of esthetics in dentistry. Case Rep Dent. 2013;2013:1–4. doi:10.1155/2013/951589

13- Bertassoni L, Martin J, Torno V, Vieira S, Rached RN, Mazur R. In-office dental bleaching and enamel microabrasion for fluorosis treatment. J Clin Pediatr Dent. 2008;323:185–8. doi:10.17796/jcpd.32.3.20757r27312334u8

14- Shahroom NB, Mani G, Ramakrishnan M. Interventions in management of dental fluorosis, an endemic disease: A systematic review. J Family Med Prim Care. 2019;810:3108. doi:10.4103/jfmpc.jfmpc_648_19

15- Kikly A, Jaafoura S, Bouslama A, Belghuith AC, Zokkar N, Douki N. Understanding and performing enamel micro-abrasion: A case report. Medicina (MJD). 2024;83:52–52. doi:10.30654/MJD.10052

16- Villalobos-Tinoco J, Jurado CA, Rojas-Rueda S, Citrin NS, Colvert S, Gutierrez-Quintero JL, et al. Micro- and macroabrasion in the esthetic zone: A narrative review and case study. Dent J (Basel). 2025;135:183. doi:10.3390/dj13050183

17- Alyahya Y. A narrative review of minimally invasive techniques in restorative dentistry. Saudi Dent J. 2024;362:228–33. doi:10.1016/j.sdentj.2023.11.005

18- Srivastava R, Tangade P, Priyadarshi S. Managing dental fluorosis: A guide to improving appearance of the teeth. Advances in Dental Research. 2023;131:25–9. doi:10.18231/j.adr.2023.005

19- Guyonvarch R, Estivals J, Kérourédan O. Minimally invasive direct approach for severe dental fluorosis: Balancing aesthetics and quality of life. Clin Case Rep. 2025;132:e70254. doi:10.1002/ccr3.70254

20- Alwadai GS, Huaylah SH, Althobati MK, AlMutairi FA. Multi-modal management of dental fluorosis in a family: A case series. Medicine (Baltimore). 2025;10415:e42082. doi:10.1097/MD.0000000000042082