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# RESEARCH ARTICLE

## AN OVERVIEW ON MANAGEMENT OF DENTAL FLUOROSIS: A COMPREHENSIVE REVIEW

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## ABSTRACT

Dental fluorosis is a disorder of dental enamel formation brought on by repeated exposure to high fluoride concentrations when teeth are developing, resulting in enamel with lower mineral content and increased porosity. Fluoride prevents dental cavities by promoting remineralization and preventing demineralization at the crystal surfaces inside the tooth. But the excessive consumption or inhalation of fluoride causes dental fluorosis. The severity of the changes depends on the amount of fluoride ingested; it is a disease that has an epidemiological behaviour with endemic characteristics. Treatment options for dental fluorosis include such type of procedures which will help in improvising appearance of the tooth particularly as this condition leads to altered appearance of the teeth.



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# INTRODUCTION

Dental fluorosis is a developmental disturbance of dental enamel, caused by successive exposures to high concentrations of fluoride during tooth development, leading to enamel with lower mineral content and increased porosity.(1)Fluoride levels in the plasma are connected to how severe fluorosis is. Many factors, such as total fluoride intake, method of intake (inhaled or swallowed), renal function, pace of bone metabolism, metabolic activity, etc., affect plasma fluoride levels in the body. The degree of enamel fluorosis has also been demonstrated to be influenced by genetic factors in addition to these other variables.(2)The maximum concentration of fluoride in drinking water that the WHO recommends is 1.5 mg/l. (3)Aesthetic alterations in dental fluorosis are the main cause of worry. Between the ages of 20 and 30 months, children are more susceptible to this issue if they are exposed to fluoride in excess. Fluoride overexposure is most dangerous between the ages of one and four. Fluoride ingestion is safe within a daily range of 0.05–0.07 mg F/kg. (1) The main cause of endemic dental fluorosis is fluoride in drinking water exceeding 1.5 mg/L.(3) Moreover, incidences of fluorosis linked to toothpaste, fluoride supplements, infant formula, and seafood consumption have been documented.(4)In recent years, a new, more conservative approach has been developed to stop and control initial carious lesions. Treatment of dental fluorosis depends on its severity. In mild fluorosis, micro abrasion, bleaching, and a combination of both are also suitable treatment options. The indicated management for TF1 and TF2 lesions is dental bleaching or resin infiltration for TF3 and TF4 micro abrasion and/or bleaching, and in TF5 a combined technique with macro, micro abrasion, and dental bleaching. Other approaches can also be performed, such as laminated crowns and veneers.(5)

### TREATMENT METHODS

Prevention is the best approach to the management of dental fluorosis, but when severely fluorosed teeth are aesthetically objectionable, restorative management may be indicated. In milder cases with dis-coloration, tooth-whitening procedures or micro-abrasion may be beneficial.

### PREVENTIVE MEASURES

De-fluoridation Dental fluorosis is best prevented by avoiding excessive fluoride intake during the late secretory and maturation phases of enamel, a period that extends to 3-4 years of age for permanent anterior teeth. Thus, drinking water in areas with endemic dental fluorosis should be de-fluoridated to contain appropriate fluoride levels". Depending on the climatic conditions, fluoride concentration of 0.7-1.2ppm is generally considered appropriate, and the World Health Organization has set the upper limit at 1.5ppm.(6)

### CONTROLLED USE OF FLUORIDE IN PREVENTIVE DENTISTRY

Consideration should be given to fluoride ingestion from drinking water and other sources before prescribing fluoride supplements so as not to overburden the tissue fluids with excessive fluoride during the

period of tooth formation. Daily fluoride ingestion of 0.05-0.07mg/kg body weight during enamel formation is generally regarded as optimal." or as an upper limit". (7)The widespread use of fluoride toothpaste is sometimes regarded as one of the major risk factors for the increase in the prevalence of dental fluorosis in areas with fluoride-deficient public water supplies. Tooth brushing by children aged below 5 years should be supervised: the amount of toothpaste used each time should be related to their age and/ body weight and they should be encouraged to spit out the toothpaste after brushing.(8)

## MANAGEMENT OF FLUOROSIS BY THERAPEUTIC MEASURES

Discoloration of teeth is the primary reason patients seek treatment for fluorosed teeth. This discoloration may result from white opacities due to enamel hypomineralization. The absorption of extrinsic stains into the porous subsurface enamel can lead to discoloration, which may appear yellowish, light brown, dark brown, or black (9)

## BLEACHING

*Akpata* suggested that mild fluorosis with T-F score of 1-2 should be managed by bleaching, as the subsurface porosities may be sufficiently superficial for the entrapped extrinsic stains to be removed by the bleaching agent.(10) To facilitate the penetration of the bleaching agent into the subsurface porosities of the enamel, the hypermineralized surface enamel may be etched with phosphoric acid. (9)Discoloured, mildly fluorosed teeth have been treated by in-office or at-home bleaching or a combination of both. Hydrogen peroxide (35%) and carbamide peroxide (10%) are the commonly used bleaching agents. High concentrations (e.g. 35% hydrogen peroxide) of the bleaching gel are used for in-office bleaching. Before applying the gel directly to the teeth, they are isolated and cleaned. The action of the gel can be enhanced using a halogen or light-emitting diode (LED) curing light. Multiple in-office bleaching sessions may be needed to achieve the desired results. To help the bleaching agent penetrate the subsurface porosities of the fluorosed tooth, the hypermineralized surface layer may be conditioned with 37% phosphoric acid. After in-office bleaching, at-home bleaching can be continued until the desired shade is reached.(11)Enamel blemishes caused by dental fluorosis may also be addressed using Wright's protocol. The fluorosed tooth is first cleaned with prophylaxis paste. The enamel surface is then etched with 35% phosphoric acid to enhance the penetration of sodium hypochlorite, which serves as the bleaching agent. The bleaching process may be repeated until the desired shade is achieved. After bleaching, the enamel pores are sealed with a low viscosity resin composite to prevent further stain absorption into the subsurface porosities (12)

**Different concentrations of carbamide peroxide and hydrogen peroxide were used:**

- 20% carbamide peroxide (Opalescence/Ultradent, USA),
- 10% carbamide peroxide (NuProgold/Dentsply, USA)
- 7.5% hydrogen peroxide (Day White/Discus Dental, USA)


**Fig. 1. Bleaching of Fluorosed Teeth (Source: Katarmal DB. Dental Bleaching for Fluorosis of Teeth [Internet] [cited 2024 Sep 6]**

## MICROABRASION

Microabrasion is frequently used in conjunction with bleaching to effectively eliminate fluorosis stains. It is considered the treatment of choice for mild fluorosis (TFI = 1-3), though it can also be attempted in cases of moderate fluorosis (TFI = 4). The discolored tooth is first etched with phosphoric acid, after which a thick mixture of pumice and 18% hydrochloric acid is applied to abrade the tooth surface. This process removes both the enamel porosities and the entrapped extrinsic stains.(4) To mitigate tooth hypersensitivity following microabrasion, amorphous calcium phosphate (ACP) is applied. Additionally, a complex of casein phosphopeptide (CPP) and ACP has shown potential in reducing the opaque white discoloration associated with enamel fluorosis by promoting remineralization. A combination of microabrasion and at-home bleaching is recommended, along with chair-side restoration of the superficial enamel microstructure. In this approach, microabrasion targets the removal of the hypermineralized, white-colored superficial enamel layer, while at-home bleaching focuses on eliminating the extrinsic stains trapped within the subsurface porosities. One case made use of Opalustre (Ultradent) for microabrasion, then sodium fluoride to minimize hypersensitivity, followed by at-home bleaching with 10% carbamide peroxide for 2 weeks. Finally, the enamel surface was reshaped with fine-grit diamond to recreate natural enamel appearance.(4) microabrasion is only recommended for mild fluorosis treatment. Faster techniques for removing fluorosis stains, often called macroabrasion, have been proposed. These methods include using fine-grit diamond points at high speed or sandpaper discs at low speed. While effective for addressing deep-seated fluorosis stains, these methods may also lead to excessive removal of tooth tissue.(4)


**Fig 2. Microabrasion of maxillary anterior teeth with mild fluorosis (TFI = 3): (a) - Preoperative, (b) - Postoperative. )(Source: Akpata ES. Therapeutic management of dental fluorosis: A critical review of literature. Saudi J Oral Sci. 2014 Jun;1(1):3.)**

## LAMINATE VENEERS AND FULL CROWNS

Laminate veneers are used to manage severe dental fluorosis, especially where there has been surface enamel loss. It has been suggested that teeth with TFI = 5-7 should be restored with laminate veneers. Likewise, cases with TFI = 4 in which microabrasion or macroabrasion have not been successful. The veneer may be made of porcelain or resin composite.(10)

Since adhesive bonding to enamel yields more predictable results than bonding to dentin, laminate veneers are not recommended when over 30% of the labial enamel has been lost. Significant enamel loss makes it challenging to avoid placing the veneer preparation margins in dentin, which can increase the risk of postoperative sensitivity. Consequently, it is advised that teeth with a TFI of 8-9 be crowned, as

these fluorosed teeth have lost more than 50% of their enamel. Porcelain laminate veneers are known for their excellent track record, providing outstanding appearance and predictability while being biocompatible. In contrast, resin composite laminate veneers have several drawbacks, including marginal staining, material loss, and gingival irritation.(10)After removing 0.3-0.5 mm of labial enamel during preparation of a severely fluorosed tooth for a laminate veneer, there may be residual enamel discoloration. The enamel stain should be removed by in-office bleaching, using 25-38% hydrogen peroxide or 35-40% carbamide peroxide. (10)The depth of etch of non-fluorosed teeth is affected not only by the type and concentration of the acid etchant, but also by the etching time and the chemical composition of the enamel. Because the fluorapatite in the hypermineralized surface layer of fluorosed teeth is more resistant to acid dissolution than the hydroxyapatite in non-fluorosed teeth, it has often been suggested the etching time of fluorosed enamel be doubled.(13)Pre-etching with 37% phosphoric acid improved bonding to moderately and severely fluorosed enamel when self-etching primer was used. (14)

**Fig 3. patient with severe dental fluorosis: Pre-operative andMaxillary and mandibular dentition after final restoration with all ceramic crown(source: Lee JD, Inoue N, Lee C, Park S, Lee SJ. Comprehensive Management of Severe Dental Fluorosis with Adhesively Bonded All-Ceramic Restorations. Prosthesis. 2021 Sep;3(3):194–208.**

**RESIN INFILTRATION TECHNIQUE**

Icon is a minimally invasive method that effectively masks fluorotic lesions, with a treatment time shorter than that of micro-abrasion or conventional restorative options, making it particularly advantageous for pediatric patients. Unlike bleaching therapy, which can decrease the microhardness of demineralized enamel surfaces, the resin infiltrant is thought to mechanically strengthen the enamel structure.(15)The commercial infiltration product used is based on triethylene glycol dimethacrylate (TEGDMA). Fluorosis spots already have porous enamel; therefore, the resin can penetrate more easily. Ethanol at a 99% concentration is used to remove water from the pores, facilitating the resin's penetration. The resin must be applied twice because the first application causes contraction of the material as the monomers convert to polymers, resulting in the generation of spaces. The second application must fill these spaces. Resin infiltration proves to be a good option to mask spots associated with mild to moderate fluorosis. Moreover, it is a relatively quick, inexpensive, and minimally invasive treatment. Application of Icon Etch (15%HCl) for 2 minutes. After rinsing and drying if the white spot is still visible application of Icon Etch should be repeated. After the application of Icon Infiltrant and light-curing for 60 seconds, the spot is well masked. (16)

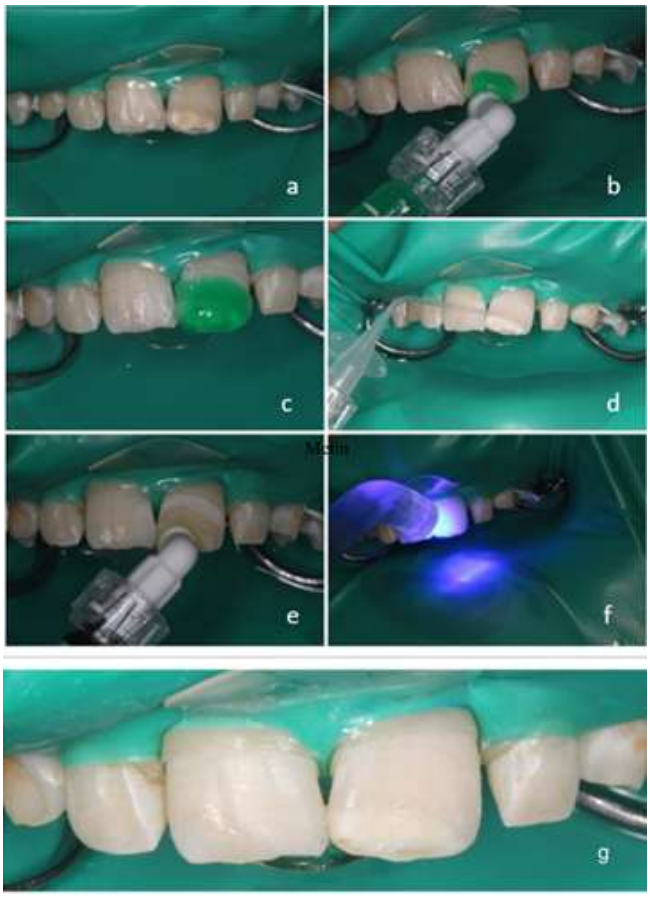


**Fig 51. Steps in Icon® application (a: Isolation with rubber dam; b: Acid application with etch syringe; c: Form of the tooth after acid application; d: Ethanol application; e: Application of resin; f: Polymerisation with light); g: Clinic photography after post treatment (Source: Clinical evaluation of resin infiltration treatment masking effect on hypomineralised enamel surfaces | BMC Oral Health [cited 2024 Sep 9]. /10.1186/s12903-023-03140-6**

Resin infiltration is found to be the best option in improving esthetics in dental fluorosis. Based on the study done by *Gugnani et al*(17) resin infiltration with additional infiltrant provides the best esthetic result compared with bleaching alone.To ensure proper erosion to the depth of the hypomineralized zone and subsequent penetration of the infiltrant, the etching is repeated several times until a visible change in the tooth's color occurs. This etching step can be repeated up to three times, allowing for deeper infiltration and improving the aesthetic outcome.(18)

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