

Management of fluorosis using resin infiltration

Abstract

Dental fluorosis is a form of hypomineralisation, which is caused by ingestion of excess amounts of fluoride during enamel formation. Fluorosis can manifest as faint, white horizontal lines running across the surfaces of the teeth, diffuse white opacities, brown staining, or pitting. Resin infiltration (Icon; DMG, Germany) can be used to treat mild to moderate forms of fluorosis yielding a more homogenous colour of the tooth. This case report is about a 37-year-old patient presenting with moderate fluorosis, which was treated with tooth whitening and resin infiltration to achieve aesthetic results.

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Introduction

Fluoride intake is well known for its role in the prevention and control of dental caries.¹ However, chronic exposure to high concentrations can have adverse effects, such as dental fluorosis. Dental fluorosis is described as hypomineralisation of enamel caused by repeated ingestion of excessive concentrations of fluoride during the pre-eruptive development of teeth.² Susceptibility to fluorosis begins at birth when the first permanent molar starts to calcify, and ends around eight years of age when enamel maturation of the permanent dentition (excluding third molars) is complete.³

Common sources of ingested fluoride include fluoridated drinking water, toothpaste, mouthwashes, fluoride supplements, and infant formula.⁴ The level of fluoride in Irish drinking water is between 0.6 and 0.8 parts per million (ppm), which is less than half the maximum permitted by the EU. This level of fluoride is deemed optimal for protecting the oral health of all age groups.⁵ The recommended level for daily fluoride intake is 0.05-0.07mg F/kg/day, which has proved to be very helpful in preventing caries by promoting remineralisation.⁶ However, a daily intake of fluoride that significantly exceeds this safe level increases the risk of dental fluorosis. It is important to note that the adverse effects of fluoride on enamel formation are cumulative, rather than requiring a specific threshold dose.⁷

The severity of dental fluorosis is directly related to the duration and amount of exposure to fluoride.⁶ Weight, age, degree of physical activity and nutritional factors also each play a role.⁶ In its mildest form, enamel fluorosis manifests as faint, white horizontal lines running across the surfaces of the teeth, or diffuse

white opacities.⁸ In more advanced cases, mottling of the teeth can be seen, with white lines or streaks coalescing into larger opaque areas.⁹ In severely fluorosed teeth, hypomineralisation extends towards the amelodentinal junction, and the enamel may be subject to brown staining or pitting, as well as post-eruptive breakdown in the most severe form.⁹

Numerous treatment options are available for fluorosis, including:

- (a) tooth whitening, which comprises bleaching the teeth with carbamide peroxide to possibly minimise the contrast between the fluorotic whitish opacities and sound enamel;
- (b) enamel micro-abrasion, in which a combination of a low-concentration acid and an abrasive compound (pumice) is used to erode the surface and subsurface of the affected enamel, exposing the underlying sound enamel;
- (c) porcelain veneers; and,
- (d) resin infiltration, which involves very minimal wear of the surface enamel, exposing the porous subsurface, which is subsequently infiltrated by a low-viscosity resin that has a refractive index similar to sound enamel.¹⁰

Bleaching alone is usually insufficient to provide a complete visual merging of the fluorotic enamel to the sound enamel. Although micro-abrasion and veneers are effective, they necessitate a more invasive approach that involves removing the entire damaged enamel. Resin infiltration appears to be a suitable alternative that provides satisfactory results while being minimally invasive.

The aim of this case report is to describe in detail the resin infiltration protocol involved in the aesthetic treatment of a moderate case of fluorosis.



Dr Fahad Khan DMD MFDS RCPS (Glasg)

MSc Restorative Dentistry
Dentist with special interest in restorative dentistry and clinical supervisor, Dublin Dental University Hospital

Saman Ashfaque

Dental student at Dublin Dental University Hospital

Corresponding author: Dr Fahad Khan, Grange Clinic, Dublin 13; drfahadkhan90@gmail.com



FIGURE 1: Intra-oral photograph showing pre-operative white and brown discolouration of the dentition.



FIGURE 3: Postoperative photograph showing significant masking of the fluorotic lesions after resin infiltration using Icon.

Case report

A 37-year-old patient presented complaining about the white spots on his teeth. A history revealed no childhood dental trauma or previous orthodontic treatment; however, excessive ingestion of fluoride was discovered when the patient admitted to swallowing toothpaste as a child. The patient reported no hypersensitivity. On visual and tactile examination, white horizontal lines with a striated appearance and white opacities were noted on all teeth present, with localised brown staining on the maxillary incisors (Figure 1). The history and examination confirmed a diagnosis of moderate fluorosis.

A conservative approach was proposed to the patient to manage this case of fluorosis, which was comprised initially of tooth whitening followed by resin infiltration using Icon, and the patient provided informed consent for this treatment plan. 16% carbamide peroxide was prescribed to the patient for at-home bleaching, and this was carried out for four weeks (six to eight hours per night) in order to brighten the overall appearance of the teeth and reduce the opaqueness of the fluorotic discolourations. After whitening was completed, 10 days were allowed to pass before carrying out resin infiltration. This allows the free radicals from the bleaching agent to be washed away so that they do not interfere with polymerisation of the resin.¹¹ The steps for resin infiltration using Icon are outlined as follows:



FIGURE 2: Intra-oral photograph of the IsoPrep retractor in the patient's mouth. This photograph was taken after the patient had carried out tooth whitening for four weeks and, as a result, the brown stains and white horizontal lines have diminished.

1. Isolation

A well-isolated working field is essential, as the initial phase involves etching the teeth and the use of resin. This can be achieved using rubber dam isolation or an Optragate retractor (Optragate lip and cheek retractor; Ivoclar Vivadent, UK). In this case, the IsoPrep retractor (from the Philips Zoom in-surgery whitening kit) was used, which provided sufficient lip, cheek and tongue retraction (Figure 2).

2. Cleaning

All tooth surfaces were cleaned with pumice prior to etching.

3. Etching

Icon-Etch (15% hydrochloric acid) was applied to the tooth surfaces for two minutes and then rinsed away completely with water. This step aims to remove the well-mineralised enamel surface layer and create access to the subsurface hypomineralised fluorotic enamel.

4. Drying

Icon-Dry (ethanol) was applied to the tooth surfaces for 30 seconds. This step gives the operator a preview of the masking effect after Icon-Infiltrant is applied. This assessment was performed together with the patient and, in this case, steps 3 and 4 were repeated five times to prepare the enamel surfaces sufficiently to achieve the desired aesthetic result.

5. Resin infiltration

Teeth were dried before massaging Icon-Infiltrant (low-viscosity resin) onto the tooth surfaces for three minutes to allow sufficient penetration of resin. Excess resin was removed using cotton wool and dental floss.

6. Curing

The infiltrant was light-cured for 40 seconds.

7. Second resin infiltration

Icon-Infiltrant was massaged onto the tooth surface for a second time for one minute to compensate for polymerisation shrinkage, followed by further light curing.

8. Polishing

Polishing disks (Sof-Lex; 3M, USA) were used to polish the infiltrated enamel areas (Figure 3).

Discussion

Fluorotic lesions present with a high degree of subsurface porosity, and these microporosities are filled with either a watery medium or air.¹⁰ Both of these entities have a refractive index (RI) significantly different to that of sound enamel. Due to the difference in RIs between the enamel crystals and the material inside the porosities, light scattering occurs and the fluorotic lesions appear opaque.¹⁰ However, the refractive index of the resin infiltrant is similar to that of sound enamel, so when the infiltrant penetrates the microporosities, the lesions appear similar to the surrounding sound enamel, as the difference in RIs between the sound enamel crystals and the resin infiltrant is negligible.¹⁰ Fluorotic spots can be upsetting for patients as they often compromise dental appearance. The clinical objective of treating this type of tooth discolouration should be achieving an acceptable aesthetic result in the least invasive manner possible. As no mechanical removal of enamel is required, Icon is a minimally invasive approach for effectively masking fluorotic lesions. Furthermore, the treatment time is shorter than micro-abrasion or conventional restorative treatment options, which can serve as an advantage when dealing with paediatric patients. In contrast to bleaching therapy, which can reduce the microhardness of demineralised enamel surfaces,¹² the resin infiltrant is considered to mechanically strengthen the enamel structure.¹³ However, as is the case with tooth whitening and enamel micro-abrasion, the treatment outcome of resin infiltration also depends on the severity of the fluorotic areas. In some situations, only an improvement, rather than a total masking of the fluorotic lesion, can be obtained.¹⁰

In this case, the masking effect of resin infiltration was deemed highly satisfactory by the patient despite the fact that a few fluorotic areas simply became less noticeable instead of being completely erased. The success of this treatment can be attributed to tooth whitening prior to resin infiltration and repeating the Icon-Etch step five times until an acceptable preview of the final result was obtained during the Icon-Dry step.

Conclusion

This case demonstrates that a moderate case of fluorosis can be effectively masked with a minimally invasive technique such as Icon resin infiltration, without the need for abrasion and mechanical tooth preparation. Although aesthetic results were obtained, the long-term effectiveness of resin infiltration has yet to be evaluated.

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1. The recommended level for daily fluoride intake is:

- ☐ A: 0.05-0.07mg F/kg/day
- ☐ B: 0.20-0.25mg F/kg/day
- ☐ C: 0.10-0.15mg F/kg/day

2. Dental fluorosis is described as the hypomineralisation of:

- ☐ A: Enamel
- ☐ B: Dentine
- ☐ C: Cementum

3. The difference in refractive indices (RIs) between the sound enamel crystals and the resin infiltrant is:

- ☐ A: Significantly different
- ☐ B: Completely identical
- ☐ C: Negligible