Clinical Case Reports

WILEY

Clinical Case Reports Open Access

CASE REPORT OPEN ACCESS

Minimally Invasive Direct Approach for Severe Dental Fluorosis: Balancing Aesthetics and Quality of Life

Rosa Guyonvarch[1,2] | Julia Estivals[1,2,3] | Olivia Kérourédan[1,2,4,5]

[1]University of Bordeaux, UFR Des Sciences Odontologiques, Bordeaux, France | [2]CHU de Bordeaux, Pôle de Médecine et Chirurgie Bucco-Dentaire, Bordeaux, France | [3]University of Bordeaux, CNRS, MCC, PACEA, UMR 5199, Pessac, France | [4]Centre de Compétence Des Maladies Rares Orales et Dentaires, CCMR O-Rares, Bordeaux, France | [5]INSERM, BioTis, U1026, University of Bordeaux, Bordeaux, France

Correspondence: Olivia Kérourédan (olivia.kerouredan@u-bordeaux.fr)

Received: 10 January 2025 | **Revised:** 27 January 2025 | **Accepted:** 4 February 2025

Funding: The authors received no specific funding for this work.

Keywords: aesthetics | dental fluorosis | enamel microabrasion | follow-up studies | quality of life | tooth bleaching

ABSTRACT

Dental fluorosis, a condition caused by excessive fluoride intake during enamel formation, can significantly affect patients' quality of life due to aesthetic concerns. Depending on severity, treatment options range from bleaching or resin infiltration to more invasive techniques like veneers or crowns. In this article, a young patient with severe dental fluorosis underwent a stepwise, personalized and minimally invasive treatment including bleaching, micro- and macro-abrasion, resin infiltration, composite resin layering and composite resin injection. The results highlight the positive impact on the patient's quality of life, as evidenced by the reduction in the Oral Health Impact Profile 14 (OHIP-14) score from 23 to 0, and the effectiveness of these conservative techniques in achieving satisfactory aesthetic outcomes. This case report highlights that minimally invasive approaches can effectively restore dental aesthetics in severe fluorosis cases, significantly enhancing patients' quality of life—including psychological and social well-being—while preserving tooth structure.

1 | Introduction

The aesthetic appeal of a smile is paramount in contemporary society, significantly influencing personal, social, and professional interactions. Anomalies in dental appearance, such as dental fluorosis, can result in profound psychosocial distress. The perception of dental aesthetics is closely tied to self-esteem and social confidence, impacting individuals' overall quality of life. Studies have shown that individuals with dental imperfections often experience anxiety, social withdrawal, and diminished self-confidence, underscoring the critical need for effective cosmetic dental interventions [1, 2].

Dental fluorosis is a disorder characterized by the hypomineralization of enamel due to excessive fluoride intake during tooth development. Depending on the degree of severity, fluorosis manifests as white and/or brown stains, and in severe cases, pitting of the enamel surface [3]. The prevalence of dental fluorosis varies globally, with higher rates in regions with high natural fluoride levels in drinking water or in populations with improper use of fluoride-containing products [4]. This condition not only compromises dental aesthetics but also adversely affects the quality of life, leading to psychological and social challenges [5, 6].

The impact of dental fluorosis on quality of life has been well documented. Affected individuals often report embarrassment, reluctance to smile, and reduced social engagement [7]. These psychological effects highlight the necessity for effective therapeutic strategies to restore dental aesthetics and improve patients' well-being. Current treatment options for dental fluorosis range from conservative approaches to more invasive procedures, like

Summary

- This case report underscores the relevance of minimally invasive techniques in managing severe dental fluorosis, offering a balance between aesthetic improvement and preservation of tooth structure.
- The significant enhancement in the patient's quality of life demonstrates the potential of these approaches to address both clinical and psychosocial challenges, providing cost-effective and durable solutions tailored to individual needs.

veneers and crowns [8]. The concept of the therapeutic gradient is essential in this context, advocating for the least invasive procedures that achieve the desired aesthetic outcomes.

Minimally invasive techniques, such as bleaching, microabrasion, and resin infiltration, have gained popularity in the management of dental fluorosis due to their ability to conserve tooth structure while providing excellent aesthetic results [9, 10]. In parallel, the composite injection technique has been presented as a relevant minimally invasive strategy that allows for aesthetic, functional, predictable, and cost-effective outcomes [11]. In the most severe cases, the combination of these strategies could be a relevant approach to effectively mask discolorations, improve enamel appearance with minimal tooth preparation, and thus significantly improve patients' quality of life.

This clinical case report presents the management of a young patient with severe dental fluorosis using minimally invasive restorative techniques. This case underscores the efficacy of minimally invasive approaches in managing dental fluorosis and highlights their positive impact on the patient's psychosocial well-being.

2 | Case History/Examination

An 18-year-old female patient was referred to the Department of Dental Medicine at the University Hospital of Bordeaux (France) for aesthetic management of her brownish dyschromia, affecting her appearance and smile (Figure 1). The patient had grown up in an endemic fluorosis area in Senegal, where many residents exhibited similar dental anomalies. Clinical examination revealed brownish-orange and chalky white lesions with associated enamel defects, particularly in the maxillary anterior region. The patient had good oral hygiene and a healthy periodontium.

3 | Methods (Differential Diagnosis, Investigations and Treatment)

Based on the Tooth Surface Index of Fluorosis (TSIF) score, a diagnosis of severe fluorosis (Type 7) was established [12]. Additionally, an amelo-dentinal fracture of the distal angle, resulting from previous trauma, was noted.

To assess the Oral-Health-Related Quality of Life (OHRQoL), the Oral Health Impact Profile-14 (OHIP-14) was employed [13]. The OHIP-14 questionnaire addresses 14 items across 7 domains: functional limitations, physical disability, psychological disability, physical pain, psychological discomfort, social disability, and handicap, each rated on a 5-point scale (0: never, 4: very often). Scores range from 0 to 56 (0 to 8 per domain), with higher scores indicating greater discomfort. Data were collected before treatment, 2 weeks after treatment, and 6 months post-treatment, as the OHIP-14 is recognized in the literature as good clinical practice for patients' follow-up.

The treatment plan was thoughtfully devised in a collegial and multidisciplinary manner, considering the patient's age, aesthetic expectations, treatment duration, and socio-economic status. A minimally invasive approach was chosen, integrating an injected resin composite technique to offer biological, aesthetic, durable, and cost-effective benefits. Informed consent was obtained before starting treatment, and the initial OHIP-14 score was 23.

Maxillary and mandibular impressions were taken to fabricate custom thermoformed trays for external bleaching. Before bleaching, microabrasion was performed using Opalustre (Ultradent Products Inc), a microabrasive compound (6.6% hydrochloric acid with silicon carbide particles), under rubber dam isolation to enhance the effect of the whitening agent (Figure 2). The compound was applied to teeth (15–25 and 35–45) and polishing cups (Opalcups, Ultradent Products Inc) were used for

FIGURE 1 | Preoperative endobuccal photograph.

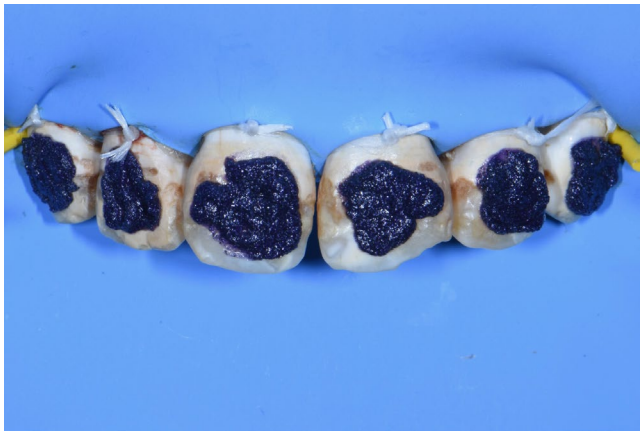

FIGURE 2 | Application of microabrasive agent (Opalustre, Ultradent Products Inc).

FIGURE 3 | Endobuccal view after microabrasion and whitening procedures.

1 min with gentle pressure, and repeated 3 times, followed by the application of a fluoride varnish (Duraphat, Colgate). Two weeks after microabrasion, the whitening agent (Opalescence PF 10%, Ultradent Products Inc) was applied using custom trays overnight for 6 weeks with regular biweekly check-ups. A remineralizing and desensitizing toothpaste (Elmex Sensitive Professional, Colgate) was prescribed to prevent sensitivity during bleaching. Post-treatment, the dyschromias were more uniform, and brown lesions appeared lighter (Figure 3).

After a 1-month cessation to stabilize tooth color and ensure optimal bonding conditions, slight macroabrasion within the enamel was performed, followed by resin infiltration (Icon, DMG). The procedure included: (i) etching with 15% hydrochloric acid (ICON etch, DMG) for 2 min with a scrubbing motion, rinsed for 30 s with water spray (Figure 4A), (ii) drying with 99% ethanol (ICON Dry, DMG) to simulate resin infiltration and remove water from the enamel microporosities (Figure 4B), (iii) applying the resin infiltrant (ICON infiltrant, DMG) for 3 min with a scrubbing motion. In the maxilla, etching was repeated three times for stain reduction, followed by two applications (3 and 1 min), each polymerized for 40 s per manufacturer's instruction.

To address enamel loss and residual dyschromia, further restorative treatments were considered. For the maxillary teeth (13–23), an injected composite resin technique was applied, based on a wax-up that corrected minor malpositions of 11 and 21 and restored the distal angle fracture of 21. A transparent silicone index (Exaclear, GC) was fabricated from the wax-up, and G-aenial Universal Injectable AO2 (GC) was injected through the index for every second tooth (Figure 5A). Polymerization was carried out through the transparent index, and excess resin was removed using a 15C blade and diamond burs (Figure 5B). For mandibular teeth, a most conservative approach was taken, involving selective ameloplasty and composite layering using the Essentia system (Essentia, GC) (Figure 6).

Finishing and polishing on both arches were completed on the same day using the Enhance Pogo system and Prisma Gloss polishing paste (Dentsply Sirona), and renewed at the follow-up visit 2 weeks later (Figure 7A).

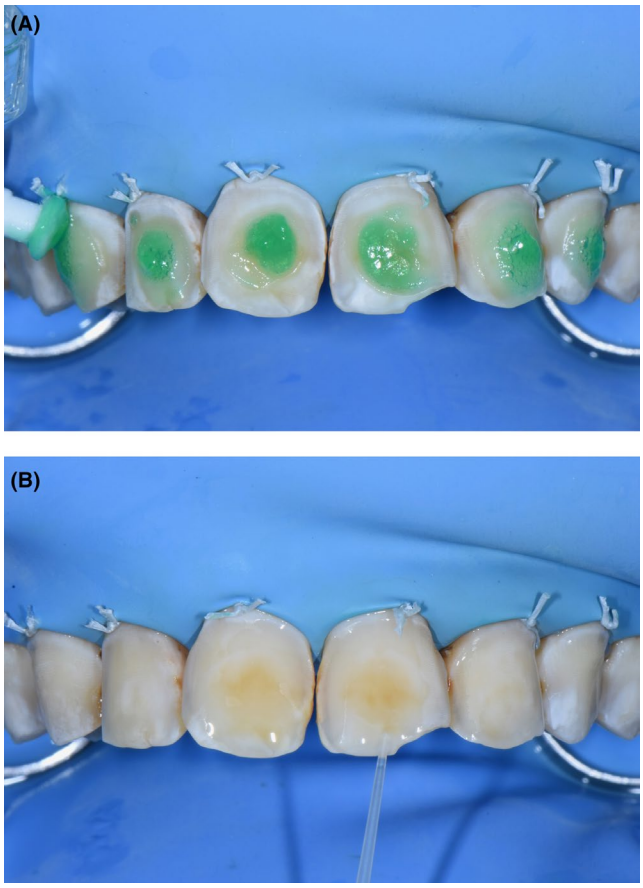

FIGURE 4 | Resin infiltration protocol. (A) Application of 15% hydrochloric acid (Icon-Etch, Icon, DMG). (B) Application of 99% ethanol (Icon-Dry, Icon, DMG).

4 | Conclusion and Results (Outcome and Follow-Up)

At the 2-week follow-up (D14), clinical outcomes were satisfactory (Figure 7B), with the OHIP-14 score markedly decreasing from 23 to 5. At the 6-month follow-up (M6), aesthetic results remained stable, and the OHIP-14 score further improved to 0. The domains most positively impacted by the treatment were psychological discomfort (ΔD0-M6 = 8), psychological disability (ΔD0-M6 = 6) and social disability (ΔD0-M6 = 4) (Table 1). Photographs taken before treatment (Figure 8A), at D14 (Figure 8B) and at M6 (Figure 8C) demonstrated significant improvement in the patient's smile aesthetics and overall OHRQoL.

5 | Discussion

Managing severe dental fluorosis presents challenges due to its aesthetic and psychological effects [14]. This case report highlights that a minimally invasive approach can yield favorable aesthetic outcomes and improve quality of life, evidenced by the reduction of the OHIP-14 score from 23 to 0 in 6 months.

The treatment plan was carefully customized to align with the patient's age, the impact of the condition on their quality of life, and practical considerations such as cost and time constraints. Unlike more invasive options like veneers of crowns that require

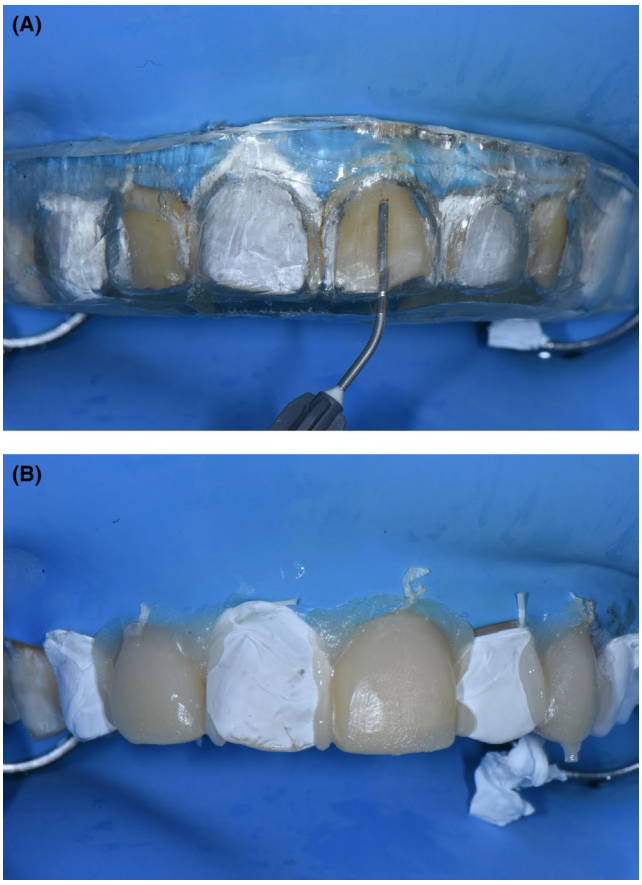

FIGURE 5 | Protocol of composite resin injection. (A) Composite resin injection through the transparent silicon index (Gaenial Universal Injectable, GC; Exaclear, GC). (B) Teeth restored using injectable composite resin before excess elimination.

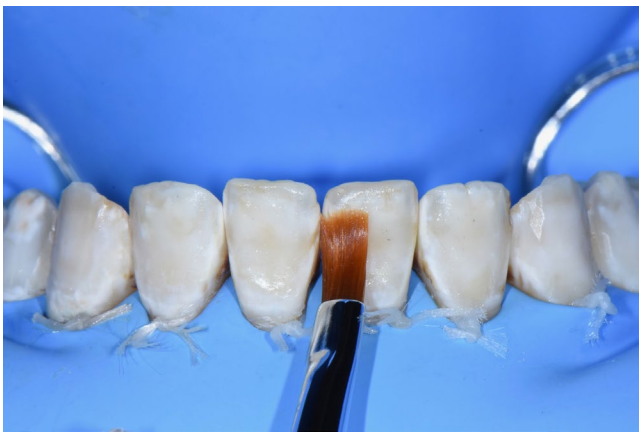

FIGURE 6 | Composite resin layering (Essentia, GC) after resin infiltration of mandibular teeth.

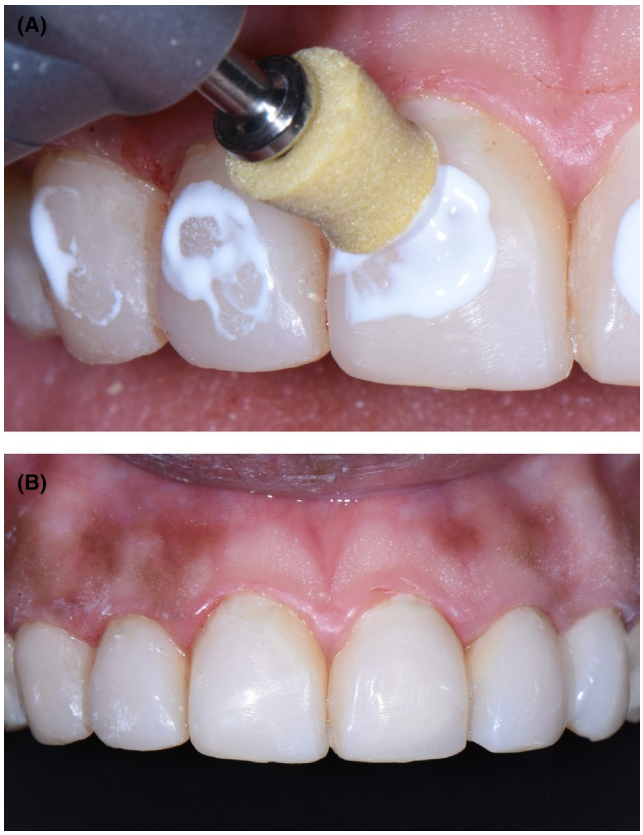

FIGURE 7 | Renewal of polishing and finishing procedures 2 weeks after treatment. (A) Application of polishing cups (Opalcups, Ultradent Products Inc). (B) Endobuccal view 2 weeks after treatment.

significant tooth preparation and may cause premature and irreversible damage [10], a stepwise, personalized approach was implemented. While the benefits and limitations of each technique were meticulously evaluated, accurately predicting the response of dental tissues remains a significant clinical challenge. Recent advances in multi-scale characterization techniques including the integration of macro-, micro-, and nanoscale structural and chemical methodologies, have provided deeper insights into Developmental Defects of Enamel (DDEs) [15]. Notably, spectroscopic and microscopic analyses conducted by Houari et al. have elucidated distinct patterns of enamel disruption: dental fluorosis is associated with a homogeneous loss of mineral content and crystallinity, primarily affecting the enamel's outer layers, whereas Molar Incisor Hypomineralization (MIH) presents with localized defects within deeper enamel layers, characterized by crystalline mineral particles embedded in an organic matrix. These findings underscore the potential of tailored restorative strategies to improve clinical outcomes for patients with severe DDEs. Moreover, the integration of advanced digital diagnostic tools, such as spectrophotometers, has been demonstrated to significantly enhance the detection and differentiation of dental fluorosis and other DDEs, enabling a higher degree of treatment customization. Spectrophotometric data can play a pivotal role in guiding clinical decisions, particularly in the selection of resin infiltration techniques or bleaching protocols, to optimize both aesthetic and functional outcomes [15]. Regarding the clinical implications of minimally invasive approaches, the results of this case align with existing studies, since microabrasion was effective in reducing surface stains and defects with minimal enamel loss [16]. Bleaching was used to enhance the masking effect of resin infiltration on fluorotic opacities [17] and to minimize enamel removal for direct restorations [18]. This combination aligns with other studies suggesting bleaching as a relevant pretreatment for both direct and indirect aesthetic restorations in fluorosis cases [19]. Resin infiltration was used to increase enamel microhardness and improve the adhesion of overlying composites [20–22]. However, the long-term stability

TABLE 1 | OHIP-14 scores before treatment (D0), at the 2-week follow-up (D14) and at the 6-month follow-up (M6) and OHIP-14 score decrease between D0 and M6 (ΔD0-M6).

OHIP-14 domains/items	D0	D14	M6	ΔD0-M6
Functional limitation	**2**	**0**	**0**	**2**
1. Have you had trouble pronouncing any words because of problems with your teeth, mouth, or dentures?	0	0	0	
2. Have you felt that your sense of taste has worsened because of problems with your teeth, mouth, or dentures?	2	0	0	
Physical pain	**1**	**2**	**0**	**1**
3. Have you had painful aching in your mouth?	1	2	0	
4. Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth, or dentures?	0	0	0	
Psychological discomfort	**8**	**1**	**0**	**8**
5. Have you been self-conscious because of your teeth, mouth, or dentures?	4	1	0	
6. Have you felt tense because of problems with your teeth, mouth, or dentures?	4	0	0	
Physical disability	**0**	**0**	**0**	**0**
7. Has your diet been unsatisfactory because of problems with your teeth, mouth, or dentures?	0	0	0	
8. Have you had to interrupt meals because of problems with your teeth, mouth, or dentures?	0	0	0	
Psychological disability	**6**	**1**	**0**	**6**
9. Have you found it difficult to relax because of problems with your teeth, mouth, or dentures?	2	0	0	
10. Have you been a bit embarrassed because of problems with your teeth, mouth, or dentures?	4	1	0	
Social disability	**4**	**0**	**0**	**4**
11. Have you been a bit irritable with other people because of problems with your teeth, mouth, or dentures?	2	0	0	
12. Have you had difficulty doing your usual jobs because of problems with your teeth, mouth, or dentures?	2	0	0	
Handicap	**2**	**1**	**0**	**2**
13. Have you felt that life in general was less satisfying because of problems with your teeth, mouth, or dentures?	2	1	0	
14. Have you been totally unable to function because of problems with your teeth, mouth, or dentures?	0	0	0	
Overall scores	**23**	**5**	**0**	**23**

of direct restorations remains a concern, as maintenance may be required due to resin degradation [23, 24].

A key achievement of this case report was the significant improvement in the patient's oral health-related quality of life, as reflected by the reduction of the OHIP-14 score from 23 to 5 at 2 weeks and to 0 at 6 months post-treatment. This underscores the progressive and sustained psychosocial benefits of minimally invasive interventions. This gradual improvement highlights the adaptability and increasing confidence of the patient over time as they become accustomed to the enhanced aesthetics of their smile. Dental fluorosis often leads to social stigma, embarrassment, and reduced self-confidence, particularly in young individuals [5]. Effective management of severe fluorosis not only restores the aesthetic appearance of teeth but also alleviates psychological distress and social withdrawal associated with the condition. By adopting minimally invasive techniques, clinicians can provide cost-effective solutions that preserve tooth structure while significantly improving patients' daily interactions, self-esteem, and overall quality of life.

FIGURE 8 | Pre- and post-operative photographs. (A) Pre-operative smile view. (B) Smile view 2 weeks after treatment. (C) Smile view 6 months after treatment.

In conclusion, despite the limited availability of long-term evidence, this case report highlights the significance of minimally invasive strategies as viable alternatives to indirect restorations for managing severe dental fluorosis. These approaches offer substantial aesthetic benefits while significantly enhancing patients' quality of life. Interdisciplinary approaches combining biotechnology, clinical research, and innovative diagnostic methods could optimize treatment protocols and improve aesthetic and functional outcomes. In this regard, research on nanostructural modifications and innovative diagnostic techniques, as reported in recent studies, represents priority areas for modern restorative dentistry.

Author Contributions

Rosa Guyonvarch: conceptualization, data curation, methodology, writing – original draft. **Julia Estivals:** conceptualization, data curation, writing – review and editing. **Olivia Kérourédan:** conceptualization, data curation, methodology, supervision, writing – original draft.

Acknowledgments

The authors would like to thank Dentsply Sirona, GC France, PRED, and Ultradent Products Inc. for their kind support, and also Mr. Abdel Serier (Dental Prosthesist, CHU de Bordeaux, France) for his contribution to this clinical case.

Disclosure

The authors do not have any financial interest in the companies whose materials are included in this article.

Ethics Statement

The publication of this case report was approved by the Research Ethics Committee of the Health and Research Ethics Centre of Bordeaux (France). The patient was informed and provided consent for the secondary use of her healthcare data for research purposes.

Consent

The authors confirm that written informed consent was obtained from the patient. The patient explicitly agreed to the publication of her clinical information and photographic material, understanding that this information will be published under open access conditions and may be freely accessed worldwide.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

References

1. P. Kaur, S. Singh, A. Mathur, et al., "Impact of Dental Disorders and Its Influence on Self Esteem Levels Among Adolescents," *Journal of Clinical and Diagnostic Research* 11, no. 4 (2017): ZC05-8, https://doi.org/10.7860/JCDR/2017/23362.9515.

2. L. A. Campos, M. A. Costa, F. S. S. Bonafé, J. Marôco, and J. A. D. B. Campos, "Psychosocial Impact of Dental Aesthetics on Dental Patients," *International Dental Journal* 70 (2020): 321–327.

3. P. DenBesten and W. Li, "Chronic Fluoride Toxicity: Dental Fluorosis," *Monographs in Oral Science* 22 (2011): 81–96.

4. L. G. Do and A. J. Spencer, "Risk-Benefit Balance in the Use of Fluoride Among Young Children," *Journal of Dental Research* 86 (2007): 723–728.

5. F. Nilchian, I. Asgary, and F. Mastan, "The Effect of Dental Fluorosis on the Quality of Life of Female High School and Precollege Students of High Fluoride-Concentrated Area," *Journal of International Society of Preventive & Community Dentistry* 8 (2018): 314–319.

6. B. K. G. Thilakarathne, L. Ekanayake, J. J. Schensul, and S. Reisine, "Impact of Dental Fluorosis on the Oral Health Related Quality of Life of Adolescents in an Endemic Area," *Journal of Oral Biology and Craniofacial Research* 13 (2023): 448–452.

7. O. Chankanka, S. M. Levy, J. J. Warren, and J. M. Chalmers, "A Literature Review of Aesthetic Perceptions of Dental Fluorosis and Relationships With Psychosocial Aspects/Oral Health-Related Quality of Life," *Community Dentistry and Oral Epidemiology* 38 (2010): 97–109.

8. N. S. B. Shahroom, G. Mani, and M. Ramakrishnan, "Interventions in Management of Dental Fluorosis, an Endemic Disease: A Systematic Review," *Journal of Family Medicine and Primary Care* 8, no. 10 (2019): 3108–3113, https://doi.org/10.4103/jfmpc.jfmpc.

9. Y. Wang, Y. Sa, S. Liang, and T. Jiang, "Minimally Invasive Treatment for Esthetic Management of Severe Dental Fluorosis: A Case Report," *Operative Dentistry* 38 (2013): 358–362.

10. L. S. Nicholas, Q. E. Yew Christopher, and L. K. Fei Frank, "Conservative Esthetic Management of Brown Enamel Fluorosis Using Combination Therapy: A Clinical Report," *Journal of Conservative Dentistry* 26, no. 3 (2023): 349–354, https://doi.org/10.4103/jcd.jcd.

11. D. Geštakovski, "The Injectable Composite Resin Technique: Minimally Invasive Reconstruction of Esthetics and Function. Clinical Case Report With 2-Year Follow-Up," *Quintessence International* 50 (2019): 712–719.

12. H. S. Horowitz, W. S. Driscoll, R. J. Meyers, S. B. Heifetz, and A. Kingman, "A New Method for Assessing the Prevalence of Dental Fluorosis—The Tooth Surface Index of Fluorosis," *Journal of the American Dental Association (1939)* 109, no. 1 (1984): 37–41, https://doi.org/10.14219/jada.archive.1984.0268.

13. G. D. Slade, "Derivation and Validation of a Short-Form Oral Health Impact Profile," *Community Dentistry and Oral Epidemiology* 25 (1997): 284–290.

14. L. S. de Castilho, E. F. e Ferreira, and E. Perini, "Perceptions of Adolescents and Young People Regarding Endemic Dental Fluorosis in a Rural Area of Brazil: Psychosocial Suffering," *Health & Social Care in the Community* 17 (2009): 557–563.

15. S. Houari, K. DeRocher, T. T. Thuy, et al., "Multi-Scale Characterization of Developmental Defects of Enamel and Their Clinical Significance for Diagnosis and Treatment," *Acta Biomaterialia* 169 (2023): 155–167.

16. D. G. Pontes, K. M. Correa, and F. Cohen-Carneiro, "Re-Establishing Esthetics of Fluorosis-Stained Teeth Using Enamel Microabrasion and Dental Bleaching Techniques," *European Journal of Esthetic Dentistry* 7 (2012): 130–137.

17. C. M. Schoppmeier, S. H. M. Derman, M. J. Noack, and M. J. Wicht, "Power Bleaching Enhances Resin Infiltration Masking Effect of Dental Fluorosis. A Randomized Clinical Trial," *Journal of Dentistry* 79 (2018): 77–84.

18. F. D. Jarad, C. E. Griffiths, M. Jaffri, A. A. Adeyemi, and C. C. Youngson, "The Effect of Bleaching, Varying the Shade or Thickness of Composite Veneers on Final Colour: An In Vitro Study," *Journal of Dentistry* 36 (2008): 554–559.

19. A. W. Raut, V. Mantri, P. V. Gedam, and P. P. Phabyani, "Conservative Esthetic Management of Severe Dental Fluorosis With In-Office Power Bleaching," *Annals of African Medicine* 19 (2020): 211–214.

20. S. Paris, F. Schwendicke, S. Seddig, W. D. Müller, C. Dörfer, and H. Meyer-Lueckel, "Micro-Hardness and Mineral Loss of Enamel Lesions After Infiltration With Various Resins: Influence of Infiltrant Composition and Application Frequency In Vitro," *Journal of Dentistry* 41 (2013): 543–548.

21. F. Crombie, D. Manton, J. Palamara, and E. Reynolds, "Resin Infiltration of Developmentally Hypomineralised Enamel," *International Journal of Paediatric Dentistry* 24 (2014): 51–55.

22. A. M. Kielbassa, I. Ulrich, R. Schmidl, C. Schüller, W. Frank, and V. D. Werth, "Resin Infiltration of Deproteinised Natural Occlusal Subsurface Lesions Improves Initial Quality of Fissure Sealing," *International Journal of Oral Science* 9 (2017): 117–124.

23. S. M. Elmarsafy, S. A. Abdelwahab, and F. Hussein, "Influence of Polishing Systems on Surface Roughness of Four Resin Composites Subjected to Thermocycling Aging," *Dental Research Journal* 20 (2023): 35.

24. S. Vulović, J. N. Stašić, J. Ilić, M. Todorović, D. Jevremović, and A. Milić-Lemić, "Effect of Different Finishing and Polishing Procedures on Surface Roughness and Microbial Adhesion on Highly-Filled Composites for Injectable Mold Technique," *Journal of Esthetic and Restorative Dentistry* 35 (2023): 917–926.