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Case Report

A Digital Approach to Managing Dental Fluorosis with Ceramic Veneers: A Case Report

Walid Jallouli[1], Hanen Boukhris[2], Imen Khalghoum[3]* and Dalenda Hadyaoui[3]

[1]Private Practice Dentist, Sfax, Tunisia

[2]Assistant Professor, Dental Department, Farhat Hached Hospital, Sousse, University of Monastir ,Tunisia

[3]Associate Professor in Dental Medicine, Faculty of Dental Medicine, University of Monastir, Monastir, Tunisia

***Corresponding Author:** Imen kaghoum, Associate Professor in Dental Medicine Faculty of Dental Medicine, University of Monastir, Monastir, Tunisia.

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Abstract

Introduction: Fluorosis is a condition that affects dental enamel. Primarily caused by excessive fluoride intake during childhood, it manifests as brown and white spots on the tooth surface and can progress to severely chalky, opaque, and brittle enamel.

This condition alters the appearance of the teeth and smile, prompting patients to consult their dentist for solutions to restore an attractive smile.

Teeth whitening can be a solution in some cases, but it often yields unstable and unsatisfactory results over time, especially in cases of advanced fluorosis.

The concept of tissue preservation, along with advancements in ceramics and adhesives, supports the use of dental veneers, which have become a preferred solution.

The digital tools available today, from planning to fabrication, allow for perfecting the final result of ceramic veneers. This clinical case illustrates the comprehensive digital workflow in the treatment of a patient suffering from fluorosis with ceramic veneers.

Case Report: Patient Z., aged 35, presented to the dental office in Tunisia in January 2024 for aesthetic rehabilitation of her smile. The clinical examination revealed white spots covering the surfaces of the dental crowns, associated with pits and dark discolorations, indicative of moderate to severe dental fluorosis.

Treatment: The digital workflow began by capturing a digital impression and photographs via an intraoral scanner to perform a digital smile design and aesthetic analysis. A 3D-printed model was created via virtual design software, and a silicone key was used to fabricate a resin mockup and provisional veneers. Whitening was initially performed to address dark tooth discoloration. The aesthetically and functionally validated mockup guided tooth preparation, followed by a final digital impression sent to the dental lab for the fabrication of ceramic veneers. The veneers were bonded during the subsequent visit after final patient approval.

Treatment Results: The veneers were placed on teeth 15 through 25 (right second premolar to left second premolar) and reviewed one-week post treatment. The patient reported no issues and was satisfied with the final results.

Keywords: Dental Fluorosis; Ceramic Veneers; Brittle Enamel

Introduction

Dental fluorosis results from excessive fluoride intake during the development of the dental organ, specifically during amelogenesis. It typically arises from either accumulation or, more commonly, a lack of awareness of fluoride sources. Multiple sources can contribute to dental fluorosis, including exposure to fluoride-containing dental products (such as toothpaste, mouth rinses, and fluoride supplements), professional exposure and the addition of natural fluoride, artificial fluoride, or fluoride to drinking water.

In the realm of aesthetic dentistry, veneers offer a minimally invasive and highly effective solution for addressing dental fluorosis. As a conservative treatment approach, veneers preserve the majority of the natural tooth structure while providing excellent aesthetic outcomes. The integration of digital workflows-from capturing detailed digital impressions to the fabrication and bonding of ceramic veneers-has further increased the precision and predictability of this treatment. Digital tools, such as intraoral scanners and 3D printing, enable clinicians to craft highly customized veneers that

address the specific aesthetic needs of each patient. This modern approach not only improves the final appearance of the smile but also ensures a more controlled and satisfying treatment process.

This paper aims to illustrate the stages of the digital workflow used in the aesthetic restoration of teeth affected by dental fluorosis with ceramic veneers. By exploring each step of this workflow, the paper seeks to provide a comprehensive understanding of how digital technology enhances the precision, efficiency and aesthetic outcomes of this treatment.

Case Report

Patient Z., a 35-year-old woman in overall good health, presented to the dental office in Tunisia in January 2024 seeking aesthetic rehabilitation of her smile. The clinical examination revealed significant signs of dental fluorosis. Specifically, white spots covered the surfaces of her dental crowns, which were further characterized by pits and dark discolorations. These clinical findings indicated a case of moderate to severe dental fluorosis, affecting the aesthetics and functional aspects of her teeth.

Figure 1,2: Initial situation.

In addition to the visual examination, the patient reported feeling self-conscious about her smile and expressed a desire for an effective solution to restore her teeth's appearance. Given these concerns, a comprehensive treatment plan involving digital workflows and ceramic veneers was proposed to address both the aesthetic and functional issues associated with her fluorosis.

Management

During the first visit, a comprehensive dental examination was conducted to evaluate the extent of the patient's dental fluorosis. Oral prophylaxis was performed to ensure a clean surface for accurate impressions. Digital impressions were taken to create study and working models, complemented by extraoral photographs to document the patient's facial and dental aesthetics.

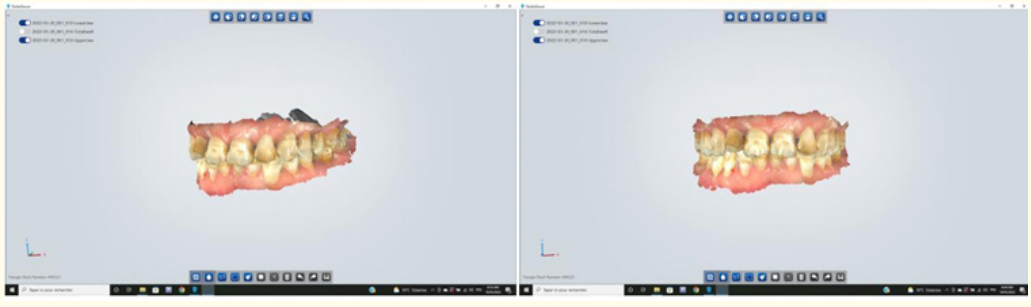

Figure 3,4: Initial digital impression.

Between visits, a digital smile design was developed via software such as Microsoft PowerPoint. This design process involved aligning the facial midline with the dental midline, incorporating facial features and smile lines, and analyzing the proportions of the anterior teeth to ensure ideal aesthetics.

A wax-up of the working model was created on the basis of this design to visualize and refine the planned restorations.

During the second visit, the patient opted for teeth whitening to address the dark discoloration caused by fluorosis.

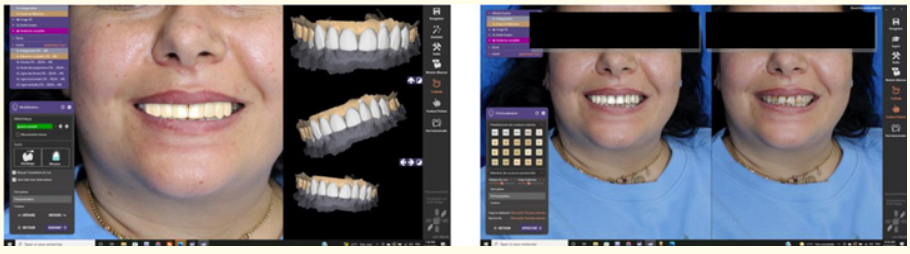

Figure 5,6: Digital Smile Design.

Figure 7: 3-D The 3D printed model.

Figure 8: Light-curable dental dam isolating the teeth before the application of the whitening product.

After the whitening treatment, a mockup based on the wax-up was created and applied to the patient's teeth. This mockup allowed the patient to preview the aesthetic outcome and served as a guide for tooth preparation.

Following the approval of the mockup, tooth preparation was carried out directly on the mockup. A specific protocol was followed for the preparation: 3 to 4 horizontal grooves were created, with their depth controlled via the mockup as a guide. These grooves were made while respecting the natural convexity of the teeth. Controlled penetration was achieved via a long-necked round bur, with the hand piece positioned against the vestibular surface. The hand piece was kept long to prevent interference with the incisal edge. Alternatively, controlled penetration could also be accomplished via stop-end burs designed for precise depth control. This meticulous approach ensured that the preparations were both accurate and minimally invasive, aligning with the planned aesthetic outcome.

Figure 9-11: Mock-up realization.

Figure 12: Dental preparation.

Once the tooth preparations were completed, a digital impression was taken via an intraoral scanner.

Temporary veneers were then fabricated using the same silicone key that was previously used for the mockup. The files from the digital impressions were sent to the dental laboratory, which then began the design and fabrication process for the ceramic EMAX veneers.

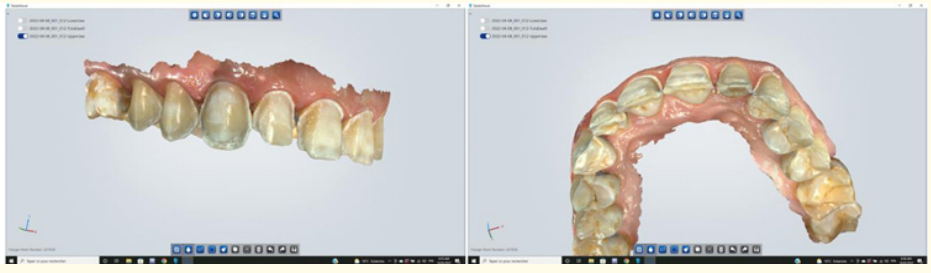

Figure 13: Digital dental impression.

During the third visit, the veneers were first tried in the patient's mouth to assess their fit, contact points, color, and overall aesthetic result. The bonding procedure involved the following steps: the internal surface of the lithium disilicate ceramics was etched with hydrofluoric acid for 20 s and then thoroughly rinsed. The ceramics were silanized for 60 s and dried. Next, the enamel was etched with 37% phosphoric acid for 15-30 rinsed, and dried. The adhesive was applied, spread thinly with an air spray, and light-cured. Bonding paste was then applied to the internal surface of the veneers, which were placed onto the prepared teeth. Excess adhesive was removed with a brush, and the veneers were light-cured under pressure to ensure a secure bond.

Figure 14, 15: Try-in of the veneers on the model and then in the mouth.

The veneers were placed on teeth 15 through 25 (right second premolar to left second premolar) and reviewed one-week post treatment. The patient reported no issues and was satisfied with the final results.

Figure 16, 17: Final result.

Discussion

Dental fluorosis is a condition resulting from excessive fluoride exposure during the development of dental enamel which are responsible for enamel formation and maturation, primarily impact the metabolism of ameloblasts. Enamel, a highly mineralized biological tissue, differs from other mineralized tissues, such as bone or dentin. Unlike collagen-based tissues, which mineralize in two stages (initial organic matrix secretion followed by mineralization), enamel formation involves a unique processing which the enamel matrix is present temporarily and then gradually replaced by minerals during the maturation phase.

Amelogenins, which are secreted by ameloblasts, constitute 90% of the developing enamel matrix and are crucial for normal enamel thickness, architecture, and composition. Research has shown that fluoride-induced inhibitory processes can disrupt the regulation of crystal growth kinetics by ameloblasts, leading to altered enamel composition and structure. This disruption results in the clinical manifestations of dental fluorosis, which vary from fine white lines to severe chalky, opaque, and brittle enamel.

Clinically, the diagnosis of dental fluorosis should be made on clean, dry teeth under adequate natural light. Fluorosis typically presents as white spots confined to the enamel, ranging from thin white lines to severely affected enamel with dark discoloration. The dark stains are often post eruptive, resulting from the incorporation of extrinsic materials into the pores of the enamel. These stains appear as horizontal lines or spots, never vertical, and are symmetrical across homologous teeth.

Dean's classification of fluorosis provides a framework for assessing the severity of the condition, which can guide treatment planning. In the context of aesthetic restoration, ceramic veneers offer a conservative and effective solution for addressing the cosmetic issues associated with dental fluorosis. The integration of digital workflows in the design and fabrication of these veneers enhances precision and outcomes, allowing customized treatment that aligns with the unique needs of each patient. This approach not only addresses aesthetic concerns but also ensures functional and durable restorations, demonstrating significant advancements in dental technology for managing fluorosis.

In managing dental fluorosis, ceramic veneers play a pivotal role. These veneers offer a conservative approach for addressing both aesthetic and functional concerns. By covering the affected enamel with a thin layer of high-quality ceramic material, veneers effectively mask discolorations and irregularities while preserving the underlying tooth structure. The precision and customization provided by digital workflows significantly enhance the outcome, allowing for the creation of veneers that closely match the natural teeth in color and shape.

The digital workflow further improves the management of dental fluorosis by integrating virtual patient simulations into the planning process. This advanced technology enables detailed digital smile designs, which incorporate virtual models of the patient's teeth and facial aesthetics. Through this process, clinicians can accurately predict the final appearance of the veneers and make precise adjustments before actual fabrication. This virtual approach allows for a more tailored and efficient treatment plan, optimizing both the functional and aesthetic results. The integration of digital technology in the design and fabrication of ceramic veneers not only demonstrates a significant advancement in aesthetic dentistry but also offers an effective remedy for the challenges posed by dental fluorosis [1-15].

Conclusion

In conclusion, the management of dental fluorosis through ceramic veneers, enhanced by digital workflows, represents a significant advancement in aesthetic dentistry. Dental fluorosis, characterized by its impact on enamel formation and appearance, presents unique challenges that require both cosmetic and functional solutions. Ceramic veneers provide a conservative yet effective approach to address the aesthetic concerns associated with fluorosis, by masking discolorations and irregularities while preserving the natural tooth structure.

The integration of digital workflows into the treatment process further optimizes outcomes. By utilizing virtual patient simulations, clinicians can achieve precise and customized results, ensuring that the final veneers closely match the natural teeth in both color and shape. This technology enhances the accuracy and efficiency of treatment, allowing for a more tailored approach that meets each patient's specific needs.

Overall, the combination of ceramic veneers and advanced digital techniques offers a robust solution for patients affected by dental fluorosis, improving both the cosmetic appearance and functional integrity of their smiles. This approach not only demonstrates progress in the field of aesthetic dentistry but also provides a practical and effective remedy for one of the most common dental imperfections caused by excessive fluoride exposure.

Declarations

- **Funding:** Not applicable.
- **Conflicts of Interest/Competing Interests:** The author declares no conflicts of interest or competing interests.
- **Data Availability:** Data supporting the findings of this study are available upon request from the corresponding author.
- **Code Availability:** Not applicable.
- **Authors' Contributions:** Hanen Boukhris was responsible for the conception and design of the study, data collection, analysis, and writing of the manuscript.

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