

Esthetic Achievement with All-Ceramic Onlay Restorations for Rehabilitation of Compromised Fluorotic Permanent Molars

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Abstract

The focus of the restorative management of patients presenting dental fluorosis are: restore function, archive patient esthetic expectation and minimize adverse low self-esteem. Restorative treatment, however, presents difficulty managing stained and pitted teeth attributable to dental fluorosis. This case reports the attainment of conservative and esthetic outcomes where the natural fluorotic appearance aimed to be reproduced in restorations of severely carious, fluorotic posterior area in a young patient. Treatment has resulted in all-ceramic restorations conferring minimal biological cost consisted of dental porcelain layering and chromatic occlusal surface characterizations based on whitish opaque tints in order to match the most possible natural teeth appearance.

Keywords: *Ceramics; Aesthetic Treatment; Dental Caries; Dental Porcelain; Fluorosis*

Introduction

Dental fluorosis manifests by excessive consumption of fluoride resulting in disturbances in enamel mineralization. The resulting intrinsic discolorations in the maxillary and mandibular teeth with a stained and pockmarked appearance in permanent dentition are a large concern in treatment planning [1]. The management of reconstruction of structurally compromised posterior teeth by dental caries and fluorosis in a patient not having reached dental and skeletal maturity is challenging for clinicians and often requires more aggressive treatments with substantial removal of tooth structure for improving the functional and esthetic outcomes. Thus, it is essential for clinicians to effectively treat and manage esthetically compromised fluorotic defects since this abnormality has augmented in prevalence over the years, with an increase of approximately 70% in communities with fluoridated water and around 30% in populations that are not fluoridated [2].

The success of esthetic restorations in cases of fluorotic teeth depends on the understanding of patients' need, expectations once the enamel affected by fluorosis has a distinguishable appearance compared to typical dentition caused by excessive fluoride intake [1,2]. The resulting particular appearance results from disruptions that occur during the late secretory and maturation phases, this causes the retention of water and proteins, such as amelogenins causing an observable porosity in the sub-surface of enamel [3]. The visual appearance of fluorotic enamel does not show distinguishable differences; it is the dentin that accentuates the noticeable markings of the excessive fluoride exposure [4]. The dentin displays the differences in mineral composition and exudes various rings of interglobular dentin.

The association between caries susceptibility and fluorosis is reported to be influenced by diet, nutrition and oral hygiene [2]. Teeth affected by fluorosis can be more resistant or more susceptible to the caries process than sound teeth due to a greater enamel fluoride concentration and increased porosity (subsurface hypomineralization) [5]. A study by Waidyasekera, *et al.* has reported fluorotic enamel

was notably resistant to the caries process while the dentin was considerably vulnerable [2]. Furthermore, first permanent molars are imperative teeth in the mouth for maintaining the occlusal stability and function of dental arches. Therefore, require special attention during restorative strategies when severely compromised [6]. The permanent first molars are often vulnerable to enamel defects due to the chronological timing of crown development. These defects can negatively contribute to the formation of carious lesions on the teeth evident after the eruption [5]. Therefore, the prevention and management of caries disease should be particularly highlighted.

Contemporary dentistry offers a wide range of different solutions for extensive restorations when there is a need to reestablish the specific appearance of a tooth affected by dental fluorosis. Novel approaches to the traditional silver amalgams, gold alloys, or convention porcelain fused to metal crowns can help the clinician ensure acceptable esthetics with no visual distinction from the surrounding dentition. To achieve this, ceramic based tooth colored materials are proposed as alternate restorative approaches. This case study will portray the rehabilitation of permanent first molars using ceramic onlay restorations that successfully mimic the unique appearance of dental fluorosis while discussing the clinical decision related to the adopted approach.

Case Report

An 11-year-old boy was referred for restorative treatment of both permanent first mandibular molars after endodontic treatment due to extensive caries lesions. Clinical evaluation revealed the patient was at the end of the mixed dentition period, presenting with atresia of the maxillary bone and all the erupted permanent teeth exhibited enamel stains that were characterized by diffuse opaque white areas covering the entire coronal surface (Figure 1A-C). Such enamel stains are characteristic of a moderate/severe form of fluorosis. The patient and their parents reported dental fluorosis did not adversely affect the appearance of the dentition. However, they requested to have a visually imperceptible matching restoration to restore the chief complaint of extensively destroyed molars (Figure 2A and B). The dental history was non-significant with a history of no previous caries lesions nor restorations in the primary dentition.



Figure 1: 1A. Anterior view with white fluorosis staining; 1B. Upper occlusal view; 1C. Lower occlusal view.

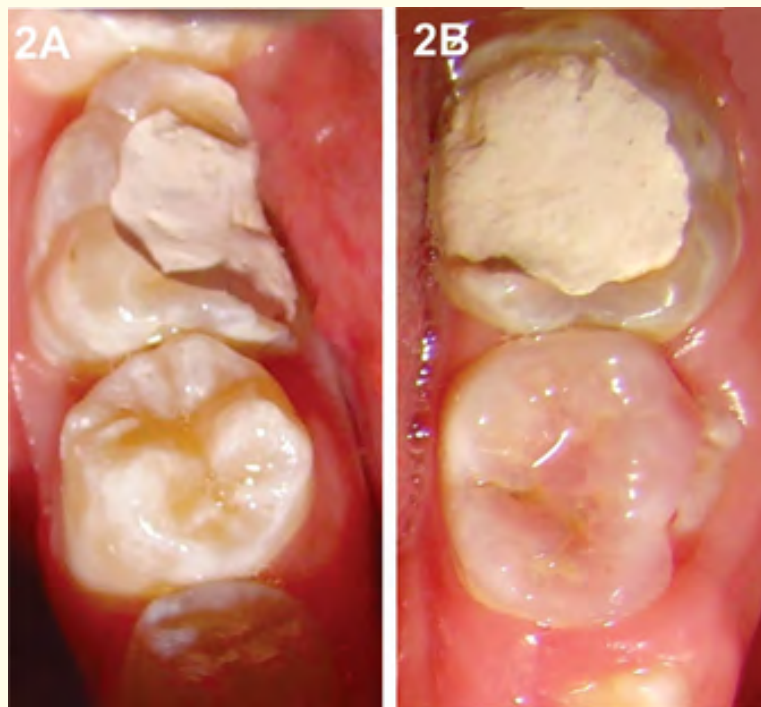


Figure 2: 2A. Pre-operative view of extensively damaged permanent first molars #19; 2B. Pre-operative view of extensively damaged permanent first molars #30.

The prognosis of the treatment plan was deemed fair-good due to the state of the first molars, which potentially required endodontic treatment and placement of prosthetic crowns. Further clinical and radiographic evaluation indicated the presence of a post was not necessary for retention of the indirect restoration. Due to severe dental fluorosis, a layered ceramic technique was utilized to mimic the appearance of the fluorotic natural dentition.

The onlay margins were located either supragingival or at the gingival margin. If a cusp was fractured or undermined, the cusp was incorporated into the onlay preparation. To create the required retention and resistance form, modified resin glass ionomer cement (resin-modified glass ionomer cement (RMGIC) (Vitremer™, 3M ESPE Dental Products, St. Paul, MN, USA) was utilized as a base. The patient received provisory restorations until the eruption of premolars to the occlusal plane.

Complete-arch impressions were made with a polyvinyl siloxane impression material (Express3M ESPE Dental Products, St. Paul, MN, USA). Along with casts and an occlusal registration, photographs were obtained to guide the dental ceramist through the clinical condition presented. These materials were sent to a laboratory for the development of the indirect restorations. The all-ceramic restorations were fabricated in glass ceramics (IPS d.SIGN; Ivoclar Vivadent AG, Schaan, Liechtenstein). Anatomic form and contour, marginal integrity, interproximal contacts, occlusion, the color of the ceramic, and surface quality were assessed. The laboratory design of the definitive restorations was followed by a porcelain layering pattern to create the multiple shades needed for this case. Considerable knowledge and artistic skill by a ceramist are prerequisites for this laboratory phase. The dental technician has focused his attention on occlusal surface characterization using white and opaque tints to correctly match the fluorotic appearance requested by the patient/ parents. In the next

step, the adhesive luting procedures were performed after inspection of the restorations in the die models. The provisional restorations were removed and the tooth preparations were cleaned with a pumice and water slurry.

The onlay restorations were evaluated intraorally. Occlusal and proximal contacts were examined. Esthetic approval of the restorations was given by both the patient and the parents. The ceramic restorations were then etched with 5% hydrofluoric acid (Dentsply, Milford, DE, USA) for 60 seconds and subsequently silanated with Monobond-S (Ivoclar Vivadent Brazil Ltda, Sao Paulo, Brazil) for 60 seconds. The crowns were cemented with adhesive resin cement (Variolink II, Ivoclar Vivadent Brazil Ltda, Sao Paulo, Brazil) with strict adherence to the manufacturer’s cementation guidelines. After cementation and finishing procedures, occlusion was carefully verified. The patient reported no discomfort or muscle fatigue with the unique restorations (Figure 3A-E).



Figure 3: 3A and 3B. Detailed view of the definitive restorations after cementation; 3C. Postoperative occlusal view; 3D and 3E. Radiographic images of first molars after final restorations.

The treatment was determined successful in restoring the function and adhering to the strict aesthetics required for this case. Orthodontic treatment was recommended to the patient, along with instructions on oral hygiene and periodontal maintenance. Regular follow-ups were scheduled, and the guardians were instructed to contact the clinic in the event of any complication. The patient returned for follow-up after 3 years with no complaint, undergoing the suggested orthodontic treatment for rapid maxillary expansion followed by fixed orthodontic appliances for correction of malocclusion with skeletal involvement.

Discussion

First permanent molars are integral in maintaining the integrity of the dental arches, which necessitates the need for special attention with mindful preventive strategies during dental restoration [6]. The objectives of restorative treatment focus on the repair, preservation of tooth structure, reestablishment of adequate function, and esthetics while providing ease in maintaining good oral hygiene [7]. In this case report, these objectives were obtained in the successful rehabilitation of two permanent first molars in a pediatric patient which presented with a specific fluorotic appearance rehabilitated by meticulous well-characterized all ceramic restorations.

Several influential factors were considered in the treatment plan for this case. It is recommended to postpone “prosthetic reconstruction” until a child reaches an advanced age; however, the endodontically-treated first molars necessitated adequate marginal adaptation provided by restorative treatment [8]. Patient motivation and cooperation are cited as an important criterion in the design of a complex restorative approach in children [9]. A careful evaluation resulted in the patient determined as physically, mentally and emotionally mature enough to handle treatment. The patient was very cooperative, allowing the complex treatment plan of the case reported.

The need for post placement in endodontically treated dentition is a key element in restorative dentistry [10]. However, posts were not utilized in this case as auxiliary means to ensure retention of the ceramic retention. A comprehensive clinical evaluation indicated the natural tooth was able to retain a core buildup and support the final restoration after the completion of caries evacuation and root canal therapy. Consulting literature, posts are not required to retain a core in the tooth with adequate ferrule, of a minimum of 1.5 mm of tooth structure coronal to the margin of the crown [11-13].

Endodontic therapy and quality prosthetic reconstruction of a decayed tooth with irreversible pulpitis contribute to the successful outcome of the treatment [14]. Endodontically treated teeth are often weaker than vital dentition. The sizable caries excavation and the removal of tooth structure in preparing an access for root canal therapy severely weaken the tooth. Frankenberger, *et al.* states endodontically treated posterior teeth have a diminished biomechanically stability, periodontal problems, and an increased probability of cuspal and vertical root fractures. Contrasted with the preferred minimally invasive restorations of vital teeth, cuspal coverage is advisable in root canal treated teeth [15].

An onlay restoration should be considered in place of a more aggressive full contour coverage approach, such as a crown during the treatment planning phase. Onlays offer the clinician an esthetic alternative with excellent translucency, precise limitations, and a combination of high wear resistance with biocompatibility [16-18]. Ceramics are more resistant to the occlusal forces than direct composite resins, which increases wear resistance. For this case, a ceramic onlay was chosen based on those properties. However, the ceramic material selection is limited by cost, time, and marginal degradation of the resin cement. Chabouis, *et al.* indicate the restorative material chosen should be based on the tooth vitality, with non-vital teeth favoring ceramic inlays and onlays over composite [16]. Hopp and Land [19] state all-ceramic restorations are an alternative predictable and successful restoration, with a significant estimated survival probability of 93.5% over 10 years. Regardless of the restorative material employed, relevant consideration should be given to the inherent constraints, such as patient compliance, operator skill, and other interdisciplinary treatment considerations. These factors are imperative in the treatment plan as well as the post-operative longevity of the restorative procedure [20].

Conclusion

In this case, a pediatric patient was experiencing fluorosis of the dentition, creating a challenging aspect to esthetics. Due to the age of the patient, conservation of tooth structure was imperative, and an onlay, rather than a crown, was chosen to restore function to the tooth. To ensure the final restoration was esthetically pleasing, porcelain ceramic was layered and stained to match the fluorotic appearance of the natural dentition. The layering technique utilized allowed a positive match to the fluorotic mineralization patterns displayed on the enamel surface of the patient’s teeth. This approach provides the clinics with a viable alternative treatment option, which allowed the preservation of natural tooth structure and patient/parents aesthetic demands.

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