



LITHIUM DISILICATE FRAGMENT TO RESTORE ANTERIOR ENAMEL HYPOPLASIA: A CONSERVATIVE APPROACH WITH 6-YEAR FOLLOW-UP

CASE REPORT

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ABSTRACT

Objective: The case reports 6-year follow-up of a lithium disilicate fragment luted on buccal surface of the right upper central incisor to restore an enamel hypoplasia lesion. **Method:** First, the tooth was whitened using at-home vital bleaching (i.e., daily use of 20% carbamide peroxide gel for 15 days) and enamel microabrasion using 6% hydrochloric acid in 5 cycles of 10 s each. The whitening techniques reduced the extension of the lesion, although without solving the unesthetic issue. Thus, a minimally invasive preparation on the remaining hypoplasia was carried out for partial restoration of the buccal surface with a glassy ceramic fragment reinforced by lithium disilicate IPS e.max Press. **Results:** The immediate clinical result showed that home bleaching added to microabrasion contributed to standardize the color of the hypoplastic enamel surface and to reduce the size of the opacity generated by hypoplasia. This allowed restoring the aesthetics and, consequently, the patient's self-esteem, using a minimally invasive technique, with preparations confined to the enamel for adhesion of the ceramic fragment. **Conclusion:** After 6-years, the functional and aesthetic result of this treatment remained satisfactory and without structural and optical clinical changes associated with the adhered fragment.

Keywords: Hypoplasia, Restorative, Ceramic, Lithium Disilicate.



1. INTRODUCTION

Enamel hypoplasia is defined as a quantitative disturbance of the mineralization of this tissue when there is insufficient deposition of organic matrix during amelogenesis.¹ It occurs due to genetic or environmental stimulus, resulting in defects and irregularities like white spot lesions, surface roughness, and grooves in the enamel. The depth of these lesions can vary significantly, directly influencing the choice of the most appropriate clinical treatment. Superficial lesions, typically limited to the outer enamel layer, can often be managed with minimally invasive procedures such as microabrasion or tooth whitening. In contrast, when hypoplasia extends into deeper layers and compromises the structural integrity of the tooth, restorative approaches using composite resins may be required, or in more severe cases, the rehabilitation with veneers or crowns. A careful assessment of lesion depth is therefore essential for effective treatment planning, allowing for individualized and targeted clinical interventions.²

Different materials and restorative techniques have been improved to satisfy a society increasingly eager for a harmonious smile, but always based on the current aesthetic concepts of minimally invasive dentistry.³ Several protocols for the treatment of hypoplastic lesions can be adopted, including but not limited to dental bleaching, microabrasion, and non-invasive adhesive restorative techniques.⁴⁻⁷ However, with the evolution of the mechanical and optical properties of ceramic systems (e.g., ceramics reinforced by leucite or lithium disilicate), together with the improvement of adhesive systems, it became possible to make extremely thin ceramic veneers of up to 0.3 mm-thick.^{8,9} Overall, advantages such as the high aesthetic standard, the maintenance of surface lighting and brightness, the high biological compatibility, and the color stability, make the glassy ceramics interesting alternative when compared to the direct application of composite resins.^{9,10}

This clinical case report aimed to describe the 6-years follow-up of a ceramic fragment bonded to an enamel hypoplasia lesion on an upper central incisor treated with home bleaching and enamel microabrasion.



2. CLINICAL REPORT

Male patient, 22 years old, dissatisfied with the aesthetics of his smile, was diagnosed with enamel hypoplasia type associated with the buccal face of tooth 11, near its incisal edge, where there was an opaque white stain mixed with some brownish color change, as well as the change in the surface texture of the enamel, which was rougher than the adjacent tooth structure (Figures 1A-C). The initial treatment plan proposed consisted of the combination of enamel microabrasion techniques and home tooth whitening.¹¹ After adapting the oral environment, the impression of the upper and lower dental arches was conducted using irreversible hydrocolloid (Orthoprint, ZhermackSpA, BadiaPolesine-RO, Italy), followed by the fabrication of the die models with special type IV plaster (Durone, Dentsply, Petrópolis-RJ, Brazil); both impression and die materials were used following the manufacturers' recommendations. After cutting the plaster models, individualized silicone trays were made with 1 mm-thick silicone plates (Whiteness, FGM, Joinville-SC, Brazil) in a vacuum laminating machine and, subsequently, the patient received instructions to undergo at-home dental whitening for a period of 15 days with daily use of a 20% carbamide peroxide whitening gel (Opalescence PF 20%, Ultradent Products, Inc., South Jordan-UT, USA); was used for 4 hours daily. Initial shade selection was performed with a VITA Easyshade digital spectrophotometer (Vita Zahnfabrik H. Rauter GmbH & Co. KG, Bad Säckingen, Germany), and shade A3 was recorded.

Figure 1: Enamel hypoplasia on the buccal surface of tooth 11



A-C, Enamel hypoplasia on the buccal surface of tooth 11 characterized by lesions of white and brown males, as well as irregular superficial depressions. Fonte: Autor Bruno Juste Paschoalino (2020).

At the end of at-home bleaching, three clinical sessions of microabrasion of the hypoplastic stain associated with tooth 11 were performed with a material containing 6% hydrochloric acid (Whiteness RM, FGM, Joinville-SC, Brazil).^{12,13} (Figures 2A-B). After removing the abrasive agent and washing thoroughly with water spray, the surface of the abrasive enamel was polished with diamond paste (Diamond Flex, FGM, Joinville-SC, Brazil) on a felt disk (Diamond Flex, FGM, Joinville-SC, Brazil), under low rotation, followed by the application of a 2% neutral sodium fluoride gel for 2 minutes.

Figure 2: Clinical aspect obtained after home bleaching with 20% Carbamide Peroxide gel for 15 days (A) and hypoplastic enamel microabrasion (B)



Fonte: Autor Bruno Juste Paschoalino (2020).

After bleaching treatments, an improvement in the clinical appearance of the hypoplastic lesion was observed; however, the aesthetic result remained unsatisfactory. Considering the patient's daily intake of an açai-based supplement, i.e., a highly pigmented and acidic food known to contribute to tooth staining, surface roughness, and chemical degradation of resin-based materials, it was decided to restore the affected tooth with a ceramic fragment using a minimally invasive approach.²⁻⁴ After 15 days of the last microabrasion session, the final shade of tooth 11 was recorded as A2 using the VITA Easyshade digital spectrophotometer (Vita Zahnfabrik H. Rauter GmbH & Co. KG, Bad Säckingen, Germany).

The hypoplastic area was carefully prepared using fine and extra-fine diamond burs (3118F, 3118FF, KG Sorensen, Cotia-SP, Brazil) at high rotation, with constant irrigation, to ensure a precise and controlled removal of the hypoplastic enamel. A 0.3 mm wear depth was created on the buccal and incisal surfaces, while a 45° bevel was formed on the palatal surface to enhance the bonding area. Next, fine-grained sanding discs (Praxis, TDV Dental Ltd, Pomerode-SC, Brazil) were used to smooth and refine the margins, ensuring a seamless integration with the surrounding healthy enamel (Figures 3A-C). In the final step, a minimally invasive preparation was achieved, preserving the integrity of the healthy enamel and ensuring an optimal surface for adhesive bonding.

Figure 3: Minimally invasive prosthetic preparation using, sequentially, fine-grained (A) and extra-fine (B) diamond burs and sanding disc (C)



Fonte: Autor Bruno Juste Paschoalino (2020).

The working impression was obtained using dense and light viscosities of a polydimethylsiloxane material (Speedex, Coltene, Rio de Janeiro-RJ, Brazil). Type IV plaster models were cast after 15 min, and on the region of the dental preparation, a wax pattern was sculpted in the shape of the planned final restoration. Later, this wax pattern was included in the coating, followed by the injection of a glassy ceramic with LiDiSi e-max reinforcement (LS2) (Ivoclar Vivadent, Schaan, Liechtenstein) (Figures 4A-D). During the laboratory phase, a temporary restoration made with light-curing composite resin, color A2 (Charisma, Heraeus Kulzer, Dormagen-NW, Germany), remained attached to the prepared tooth.

Figure 4: Fabrication of the ceramic fragment by the injection technique of glassy ceramic insert reinforced by lithium disilicate



Waxing (A), fixing the wax pattern to the crucible forming base (B), inclusion in phosphate coating (C) and final appearance of the ceramic fragment after makeup and glaze (D). Fonte: Autor Bruno Juste Paschoalino (2020).

The dry fitting of the ceramic fragment, i.e., without the use of try-in cement, was initially performed to check the adaptation, insertion axis, texture, shape, and position of the fragment. The wet fitting of the ceramic fragment involved selecting the final color of the restoration through tests with try-in cement (RelyX Try-in Resin Cement, 3M ESPE, Saint Paul-MN, USA) (Figures 5A-C). This phase aimed to select the most appropriate color of the light-cured resin cement to be used as bonding agent of the ceramic fragment to the enamel substrate.¹⁴

Figure 5: Ceramic fragment insertion procedures



Proof of the insertion axis, positioning and adaptation of the ceramic fragment to the clean dental preparation (A), wet test with try-in cement to test the influence of the color of the cement on the final color of the restoration (B), immediate aspect of the adhered ceramic fragment with light-cured resin cement on the surface of the minimally prepared enamel (C). Fonte: Autor Bruno Juste Paschoalino (2020).

The surface of the prepared tooth was etched with 37% orthophosphoric acid (Power Etching; BM4, Maringá-PR, Brazil). Then, the total-etch Adper™ Scotchbond™ 1XT adhesive system (3M ESPE, Saint Paul-MN, USA) was applied, followed by light curing using a light-emitting diode (LED RaddiCal, SDI, Bayswater, Victoria, Australia) for 20 seconds at an intensity of 1.000 mW/cm².

The internal surface of the glass ceramic fragment was treated with 10% hydrofluoric acid (Condac, FGM, Joinville-SC, Brazil) and silanized (Silano, Angelus, Londrina-PR, Brazil). Subsequently, a thin layer of adhesive was applied (Adper™ Scotchbond™ 1XT, 3M ESPE, Saint Paul-MN, USA), and the ceramic fragment was placed with the light-sensitive RelyX™ Veneer resin cement, color A2 (3M ESPE, Saint Paul-MN,

USA) and it was light-cured with the LED for 20 seconds at an intensity of 1.000 mW/cm².

After bonding the ceramic fragment, finishing and polishing of the margins were performed using the EVE Rosetta kit (Dormagen-NW, Germany). Occlusal contacts were checked with the aid of Accu Film II carbon paper (Parker, Inc., Edgewood-NY, USA), and no adjustments were necessary as the occlusion was found to be ideal.

Finally, a highly functional and aesthetically pleasing clinical result was achieved, remaining without undesirable changes after seven months (Figures 6A-B) and 6-years (Figures 7A-B) of clinical follow-up.

Figure 6: Aspect of ceramic restoration after seven months of clinical follow-up (A). Maintenance of the integrity of the restoration is observed, as well as of its margins (B)



Fonte: Autor Bruno Juste Paschoalino (2020).

Figure 7: Final aspect of the restoration after 6-years of clinical follow-up (A). Maintenance of texture and surface gloss (B)



Fonte: Autor Bruno Juste Paschoalino (2020).

3. DISCUSSION

The current literature has shown different treatment options to mask defects caused by disorders of enamel development, which can contribute to improving the self-esteem of patients affected aesthetically by stains and structural defects on the surfaces of their teeth. These treatments vary from whitening techniques and enamel microabrasion^{4,6} to direct and indirect minimally invasive restorations.^{9,15} Similarly, indirect or direct restorative techniques have always been considered for solving the unesthetic appearance of tooth with amelogenesis imperfecta, and the age and the extension of the lesions are the decisional criteria.¹⁶

Hypoplasia, as categorized by Silbermann et al.⁸ includes several types:

1) Hypoplasia Type I: enamel discoloration-induced hypoplasia;



2) Hypoplasia Type II: abnormal coalescence-induced hypoplasia;

3) Hypoplasia Type III: partial absence of enamel causing hypoplasia, and;

4) Hypoplasia Type IV: a combination of three types of hypoplasia (circular enamel hypoplasia).

In this case, only the enamel was impacted, likely due to trauma suffered during childhood. The decreased enamel shine and areas eroded by cavitations and irregular wear are characteristic signs of hypoplastic lesions, a consequence of the loss of tooth microstructure, which compromises their morphology, texture, and color.

In teeth with localized and well-defined pigmentation, characteristic of superficial hypoplasia, enamel microabrasion should be an option of choice for the rehabilitation of the affected tooth. The most conservative techniques, such as whitening and microabrasion, are indicated when there are no cavitated lesions or deep microstructural changes associated with mineralized tissues.¹⁷ Several factors have to be taken into consideration during planning treatment of the amelogenesis imperfecta, such as oral hygiene of the patient, remaining tooth structure, the age and orthodontic consideration.¹⁸

Teeth whitening is considered a more conservative aesthetic treatment option. Despite this technique does not cause wear to the enamel, it can contribute to increase its surface roughness and to reduce its microhardness.^{19,20} However, such changes are considerably minimized when the at-home whitening technique is used with carbamide or hydrogen peroxide products at low concentration.²¹ This occurs thanks to the salivary buffering capacity.²⁰ Another possible unwanted effect associated with whitening therapy is dental hypersensitivity, which has been observed very little for at-home treatment using low-concentration carbamide peroxide,^{5,22} as in this case report.

The intrinsic staining of the enamel, as presented in the current clinical case, is hardly solved with a simple home tooth whitening. Most of the time, interventions by enamel microabrasion, in order to remove the opaque white stain from the surface and to uniform the reflected tooth color, are necessary.^{12,17,23} As the correct diagnosis of the



anomaly is important to achieve a satisfactory aesthetic result, a careful analysis of the etiology and depth of the enamel opacities must precede the microabrasion procedure.

Wear of more than 100 μm of the enamel surface should be avoided^{8,25} since in addition to the structural loss of healthy enamel, a very thin layer of enamel remaining in the substrate would contribute to an adverse change in the tooth color, showing the yellowish shade of the underlying dentin.²⁶ For this reason, enamel microabrasion is contraindicated or ineffective in cases where the staining caused by the developmental defect in the enamel is severe and/or it is found in deep, especially in cases where there are also depressions on the affected enamel surface. In these cases, as in the current case reported, a restorative intervention is often necessary to mask the opacity partially removed by the minimally invasive whitening techniques previously adopted. The decision regarding the selection of the restorative technique should be left to the professional team as to its advantages and disadvantages.²⁷

Current clinical studies have been monitoring for a long time the satisfactory performance of indirect veneers made of translucent glass ceramics for functional and aesthetic recovery of compromised anterior teeth.^{28,29} From an optical point of view, vitreous ceramics have the advantage of being highly translucent and allowing a reflection of light in a very similar way to the natural tooth structure.^{30,31} In addition, the high concentration of silica in the composition of the vitreous ceramic systems makes them liable to be etched by fluorine-based acids, enabling micromechanical and chemical bonding to adhesive materials based on composite resins. No less important, partial ceramic laminates are good alternatives for the rehabilitation of esthetically compromised teeth since they are stronger than direct composite resins and they may wear out less the teeth than the conventional laminate.³² Ceramic fragments present a low occurrence of loss of adhesion and fracture, presenting a mechanical strength similar to the natural tooth.^{15,33,34}

Thanks to the development of these ceramic systems that offer excellent optical characteristics, as is the case with glass ceramics reinforced by lithium disilicate crystals, minimally invasive techniques could also be improved for the manufacture of



indirect restorations with reduced thickness ceramic laminates, i.e., up to 0.3 mm-thick.^{35,36} Thus, as in this current clinical case presented, we were able to combine the advantages of a ceramic restoration with those advantages of structural conservatism arising from the classic restorations of photopolymerizable composite resin, which, until a few years ago, were exclusive to the latter. However, when working with highly translucent ceramics in small thicknesses, the color of the dental substrate becomes an important factor in the final aesthetic result. The correct choice of a ceramic system involves the evaluation of the dental substrate, as well as the thickness of the ceramic material.^{37,38}

Clinical and laboratory studies have proven that ceramic laminates are durable and resistant restorations when properly indicated and performed.^{15,28-30} Its clinical success is directly related to the techniques and materials selected and used carefully during the adhesion and cementation procedures.^{39,40} Although the failure rate associated with ceramic laminates is considered low, most occur mainly due to failures in the technical protocol which can cause cracks, cohesive ceramic fractures, and adhesive failures over time.²⁹ It is possible to suggest that the main factor associated with the quality of the margins and the integrity of the ceramic fragment after 6-years in this clinical case was the minimum dental preparation performed. This limited the restoration to the middle and incisal thirds of the buccal surface of the crown of tooth 11 affected by hypoplasia, allowing the adhesion to occur entirely to the enamel, eliminating the involvement of the dentin substrate to the adhesion of the fragment.^{41,42} The margins were also located distant from the cervical region, where the minimum thickness of enamel and the presence of acids produced by bacteria that easily colonize the surface of cementing agents exposed to the environment close to the gingival sulcus, could contribute more easily to the occurrence of failures over time.^{30,43} Moreover, the low thickness of a highly translucent glassy ceramic fragment allows the use of light-curing resin cementing agents without prejudice to the degree of conversion of its monomers.³⁷

Finally, as demonstrated in this clinical case, the longevity of a minimally invasive ceramic restoration depends simultaneously on adequate clinical planning; the



adoption of well-defined and carefully executed operating techniques; the maintenance of adhesion as much as possible on enamel; and the use of materials with adequate optical, physical, mechanical, chemical and biological properties.⁴²

5. CONCLUSION

After 6-years of clinical follow-up, a highly satisfactory result could be observed with the ceramic fragment performed to mask the hypoplastic enamel lesion in this study.

The restoration presented quality of the margins, and the characteristics of texture and surface smoothness, gloss, and optical appearance were maintained, probably due to the structural integrity of the restoration entirely adhered to enamel.

It was also observed that the color obtained after the at-home bleaching performed at the beginning of this treatment was kept in a satisfactory manner, preventing the hypoplastic stain under the adhered ceramic fragment from interfering negatively with the aesthetic result

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