

STEP-BY-STEP SYSTEM FOR DENTAL CERAMIC AESTHETIC REHABILITATION OF ANTERIOR TEETH

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Short Communication

ABSTRACT

Stratification in dental ceramics is an essential technique for creating aesthetic and functional dental restorations that accurately mimic the appearance and properties of natural teeth. It requires a deep understanding of the materials used and technical skills to ensure high-quality results. This study aims to describe an extensive rehabilitation protocol, through a short communication, the step-by-step process of the stratification technique. The goal is to explore the different techniques for fabricating ceramic restorations, with a special focus on the stratification technique, reviewing its processing methods and highlighting the advantages and challenges associated with this approach.

Keywords: Aesthetic Zone, Pink and White Esthetic, Dental Ceramics, Dental Materials.

SISTEMA PASSO A PASSO PARA REABILITAÇÃO ESTÉTICA CERÂMICA DENTÁRIA DE DENTES ANTERIORES

RESUMO

A estratificação em cerâmica dentária é uma técnica essencial para a criação de restaurações dentárias estéticas e funcionais que imitam com precisão a aparência e as propriedades dos dentes naturais. Requer um profundo conhecimento dos materiais utilizados e habilidades técnicas para garantir resultados de alta qualidade. Este estudo tem como objetivo descrever um extenso protocolo de reabilitação, através de uma breve comunicação, o passo a passo da técnica de estratificação. O objetivo é explorar as diferentes técnicas de confecção de restaurações cerâmicas, com especial enfoque na técnica de estratificação, revendo os seus métodos de processamento e destacando as vantagens e desafios associados a esta abordagem.

Palavras-chave: Zona Estética, Estética Rosa e Branca, Cerâmica Dentária, Materiais Dentários.

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INTRODUCTION

Dental ceramics have become an increasingly popular choice in Restorative Dentistry due to their excellent aesthetic and functional properties ^{1,2}. They offer a unique combination of biocompatibility, wear resistance, color stability, and the ability to mimic the natural appearance of teeth ³. These characteristics make ceramics an ideal option for the fabrication of indirect restorations, such as crowns, veneers, inlays, and onlays ⁴.

In this regard, one of the main techniques that has gained notoriety is the stratification technique of dental ceramics, which is one of the most used approaches in prosthetic laboratories for the fabrication of aesthetic restorations ⁵. This method involves the application of successive layers of ceramic on a support structure, allowing the creation of restoration with depth and color nuances that precisely replicate the appearance of natural teeth ⁶.

Thus, stratification enables the control of translucency and opacity of the different ceramic layers, providing superior aesthetic results ⁷. The application of the stratification technique requires a high level of skill and technical knowledge on the part of the ceramist, as each layer of ceramic must be carefully applied and adjusted to achieve the desired result ⁸. Furthermore, the proper selection of ceramic materials and mastery of processing techniques are essential to ensure the durability and functionality of the restoration ⁹.

In addition, stratification also plays an important role in customizing dental restorations, allowing dentists to adapt the shape and color according to the specific needs of each patient ¹⁰. This is especially relevant in aesthetic procedures, where harmony with the patient's smile is essential ¹¹.

In this context, the present study aims to describe, through a short communication, the step-by-step process of the stratification technique. The goal is to explore the different techniques for fabricating ceramic restorations, with a special focus on the stratification technique, reviewing its processing methods and highlighting the advantages and challenges associated with this approach.



CASE DESCRIPTION

Initial Situation

A 27-year-old male patient presented seeking dental rehabilitation for his central and lateral incisors. He has a history of dental trauma during adolescence, leading to several complications and treatments over the years. These included multiple interventions due to recurrent infections and dissatisfaction with the aesthetics. The patient emphasized his preference to avoid surgical rehabilitation with implants, opting instead for a more conservative approach with a fixed prosthesis over natural teeth.

Metal Casting Procedure Status

Step-by-Step Process of Metal Casting for the Production of Dental Ceramics

1. Selection and Preparation of the Metal Choice of Metal:

- I. Select the appropriate type of metal for the base of the ceramic structure. Commonly, noble metals (such as gold alloys) or non-noble metals (such as cobalt-chrome) are used.
- II. Cleaning the Metal: Clean the chosen metal to remove any impurities or contaminants that may interfere with the casting process.

2. Fabrication of the Wax Model Wax Model:

- I. Create an exact wax model of the desired restoration. This model will serve as the pattern for the metal casting.
- II. Sprue: Attach a sprue (feeding channel) to the wax model. This will allow the molten metal to enter the mold.

3. Mold Preparation Investing:



- I. Place the wax model with the sprue in a casting ring and cover it with an investment material, which is a type of gypsum resistant to high temperatures.
- II. Hardening: Allow the investment to harden completely.

4. Wax Burnout Removal of Wax:

- I. Place the casting ring in a special furnace to melt and remove the wax from the interior of the mold, creating a cavity where the metal will be cast.

5. Metal Casting Heating the Metal:

- I. Place the selected metal in a crucible and heat it until it is completely molten.
- II. Pouring the Metal: Pour the molten metal into the investment mold through the sprue, filling the cavity left by the wax.
- III. Cooling: Allow the molten metal to cool and solidify.

6. Mold Removal Breaking the Investment:

- I. Break the hardened investment to reveal the cast metal structure.
- II. Cleaning the Metal Piece: Clean any residual investment from the metal structure using sandblasting or ultrasonic techniques.

7. Adjustment and Finishing of the Metal Structure Adjustment:

- I. Adjust the metal structure to ensure it fits perfectly in the planned restoration area.

8. Polishing:

- I. Polish the metal structure to remove any surface imperfections and prepare the surface for the application of the ceramic.

9. Application of the Ceramic Opaque Layer:



- I. Apply a layer of ceramic opaque over the metal structure to mask the color of the metal and create a uniform base for the subsequent layers.

Dental Ceramic Layering Procedure Status

Step-by-Step Dental Ceramic Layering Technique

1. Support Structure Preparation

- I. Initially, the support structure, usually a metal base or lithium disilicate, was meticulously cleaned and prepared. In this specific case, a nickel-chromium (NiCr) alloy was used, applying the bonding agent Vita Zahnfabrik – VM9, Alemanha. For nickel-chromium alloys, it's essential to perform sandblasting before oxidation, creating micro-retentions on the metal surface for optimized adhesion of the opaque to the structure. Sandblasting was carried out using 100~120µm aluminum oxide, with an air pressure of 3~4 bar or 40~60 lbs, thus removing any contamination and eliminating possible cracks in the internal surface layer. Next, a layer of opaque was applied to mask the structure's color and provide a uniform base for subsequent ceramic layers. An initial opaque firing (wash) at a higher temperature (10~20°C above conventional) was performed to ensure good metal adhesion. Following this firing, the opaque should exhibit a glossy appearance; otherwise, it indicates that the temperature or firing time may have been inadequate.

2. Material Selection

- I. Ceramic Choice: Suitable ceramic materials such as dentin, enamel, and translucent were selected according to the desired color and properties for the final restoration.

3. Application of Ceramic Layers

- I. Dentin Layer: A portion of Vita Akzent Plus Effect Stains dust (Vita Zahnfabrik, Germany) was mixed with Vita Akzent Plus Powder Fluid (Vita Zahnfabrik, Germany) until achieving a creamy consistency. The specimens were uniformly pigmented on the outer surface of the ceramic crown using a thin brush (Martha brush, Tiger, Joinville, SC), and then baked to set the pigmentation. The first layer of feldspathic dentin ceramic VM9 was applied over the support structure, shaping the basic anatomy of the tooth. It's important to note that each type of metal requires specific treatment, as insufficient or excess oxidation can influence crack formation. A layer of A1-A2 enamel ceramic was applied over the dentin, gradually building the tooth's shape and adjusting translucency. Incremental layers of translucent ceramic were applied to mimic the natural appearance of teeth, adjusting color depth and translucency (Figure 1).



Figure. 1 - Step-by-step dental ceramic layering technique. A) Opacification of the metal structure with gingival characterization to receive ceramic gingiva; B) Checking the spaces necessary to homogenize the application of the veneers; C) Metal structure on implant 22 and 23 and alveolar model for veneer on other anterior teeth 23, 11, 12 and 13; D) Application of dentin to begin creating depth in the metal-ceramic color.

4. Modeling and Adjustments

- I. Through Suspension Preparation (Paste), porcelain powder was mixed with distilled water, along with rheological modifiers and/or specific diluent provided by the manufacturer, to create a viscous suspension for use in indirect ceramic restoration construction. The porcelain powder with modeling liquid on a palette was used to form a paste, which was then applied with a brush onto a refractory matrix. The paste was applied in layers to build the anatomical shape of the tooth. Multiple layers allowed for the use of different porcelain colors to accurately replicate dentin and enamel details. Each layer of the paste was condensed, removing excess water, which could be done by vibrating the matrix and using absorbent paper or dental vibrators. The ceramic layers were modeled to recreate the detailed anatomy of the tooth, including grooves and crests. Color adjustments were made as necessary using ceramic stains and dyes to achieve the desired appearance (Figure 2).



Figure. 2 - Step-by-step dental ceramic layering technique. A) Checking the color of the



application after firing with the final color requested for the final restoration, normally we have a more saturated chroma at this point before receiving the enamel layer and incisal effects; B) Application of opaque dentin to better mask the metal structure and the opaque layer; C) Color check with remaining prepared to make future applications more predictable; D) Alveolar model with only refractories ready to receive simultaneous application on all anterior teeth.

5. Crystallization

- I. After characterization, the restoration was placed in a specific dental ceramic oven for firing VACUMAT 6000 MP (Vita Zahnfabrik, Alemanha). This process binds the powder particles, increasing density and reducing porosities. Preheating (Drying): The condensed porcelain mass was preheated (dried) at temperatures of approximately 400°-500°C for 5 minutes at the oven door. This step ensured that water evaporated slowly to avoid damage to the mass. Main Firing: Inside the oven, the restoration was heated to the maximum firing temperature of approximately 700°-980°C for 1 minute at a rate of 40°-90°C per minute. During this process, a vacuum pump created a low-pressure vacuum (0.1 atm) inside the oven. When the maximum temperature was reached, the pump was turned off, and external air (1 atm) entered the oven, increasing the pressure inside the muffle tenfold. Crystallization: This process was the coalescence of solid particles, which did not alter the chemical composition but allowed the sculpting of the anatomical shape of the dental piece. It's important to follow the manufacturer's recommendations. High Temperatures: At high temperatures, ceramic restorations didn't melt the particles; they expanded and changed, causing prosthetic structure deformation. On the other hand, at low temperatures, the material couldn't adhere to the restoration. After sintering, final adjustments were made to the anatomy and surface texture, if necessary (Figure 3).

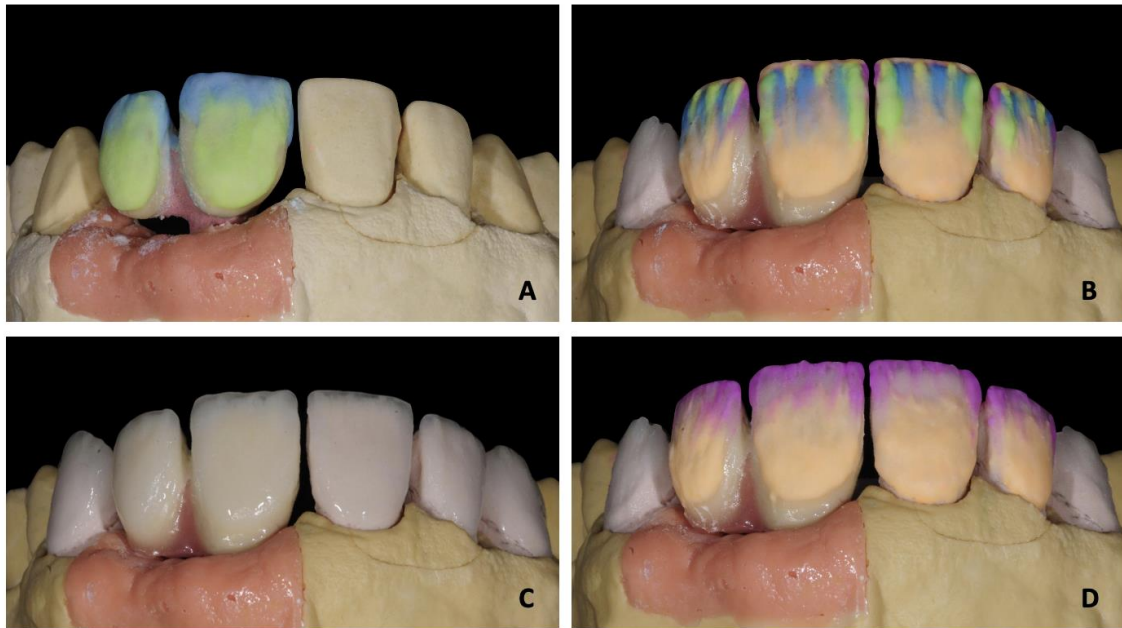


Figure. 3 - Step-by-step dental ceramic layering technique. A) Application of denatured dentin and enamel to begin to gain translucency in the restorations; B) Application of fluorescent effects (dentin infiltrate), opalescent incisal effects and characterized halo; C) Aspects after firing the ceramic layers; D) Application of denatured dentin with cervical effects and translucent light-absorbing wall.

6. Glaze and Finishing

- I. A thin layer of ceramic glaze (Vita Akzent Plus) was applied to provide gloss and protection to the restoration. Then, a second crystallization was performed to fix the glaze and finish the surface. After the ceramic had cooled to room temperature, it underwent a 5-minute ultrasonic bath in isopropyl alcohol. Following drying, the crowns were placed in a palette for the application of glaze (Vita Akzent Plus Glaze Paste, Vita Zahnfabrik, Germany) using a thin brush (Marta brush, Tiger, Joinville, SC) across all outer surfaces of the ceramic crowns. The subsequent firing of this new layer was conducted according to the specifications of each material. A ceramic blanket (quartz fiber blanket, Kota, Sao Paulo) was utilized for refractory purposes, and all procedures adhered to the manufacturer's

recommended protocols (Figure 4).

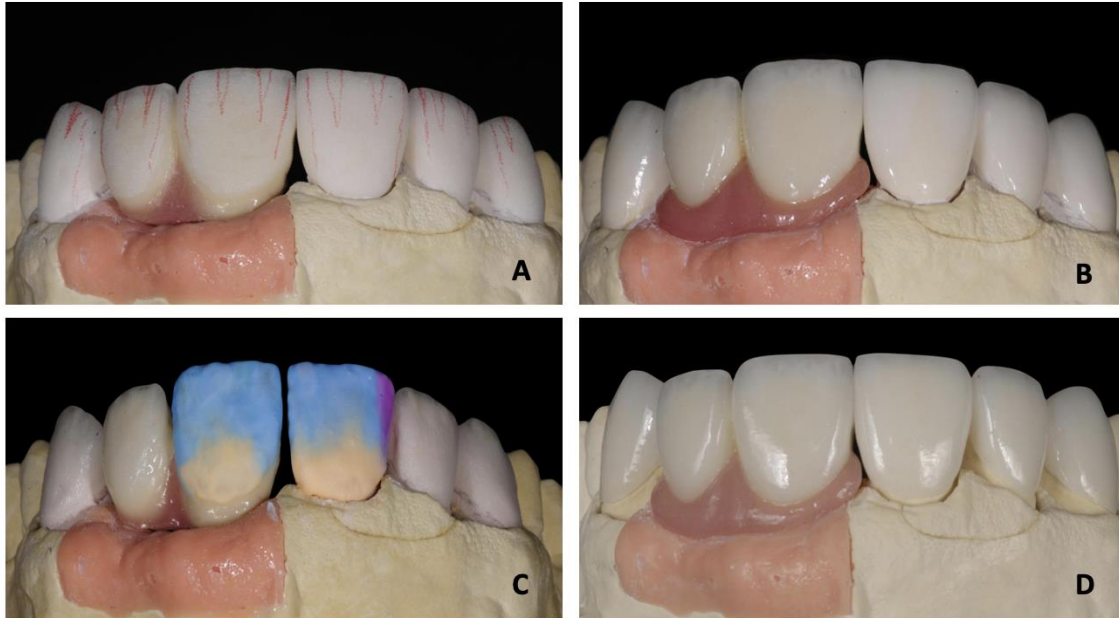


Figure. 4 - Step-by-step dental ceramic layering technique. A) Finishing and texturing before the last pre-glaze ceramic gum firing; B) Final appearance of the plaster model and in the refractories, the slight saturation of the ceramic elements on the implant can be noted. comparison with feldspathic facets, due to the white substrate of the refractory material; C) Application of a correction layer to compensate for burning contraction and refine the final morphology of the dental elements; D) Final intra-oral appearance.

7. Final Evaluation

- I. The final restoration was evaluated for occlusal fit, proximal contacts, and overall aesthetics. A final polishing was performed to ensure a smooth and glossy surface.

8. Restoration Procedure

- I. The patient's tooth and ceramic restoration were prepared for definitive cementation, following appropriate protocols to ensure long-lasting adhesion (Figure 5).



Figure. 5 - Step-by-step dental ceramic layering technique. A) Initial appearance of the intra-oral case; B) Final appearance of the plaster model and in the refractories, the influence of the A1-A2 model chorus on the final color of the feldspathic facets is noted, homogenizing the color of the final restorations; C) Aspect of the restoration of the anterior elements in the initial condition of the intra-oral case; D) Aspect of the ceramic restoration of the anterior elements in fine condition of the intra-oral case.

Discussion

Stratification in dental ceramics is a crucial process in creating aesthetic and functional dental restorations. It involves the application of layers of different ceramic materials to mimic the complexity of natural tooth structure. This technique aims not only to replicate the appearance of natural teeth but also to ensure proper mechanical properties and healthy integration with surrounding tissues. During stratification, each layer is carefully selected and applied, taking into account factors such as translucency, opacity, color, and brightness. This is essential for creating a sense of depth and realism, especially in visible areas of the mouth ^{12,13}.

However, stratification in dental ceramics requires technical skill and experience



on the part of the professional. Improper material selection or incorrect application of layers can result in unsatisfactory aesthetic results or compromise the durability of the restoration ¹⁴.

In summary, stratification in dental ceramics is an essential technique for creating aesthetic and functional dental restorations that accurately mimic the appearance and properties of natural teeth. It requires a deep understanding of the materials used and technical skills to ensure high-quality results ¹⁵.

FINAL CONSIDERATIONS

It is concluded that oral rehabilitation through the stratification of dental ceramics. However, complex and requiring high technical skill, provides superior aesthetic results and a faithful reproduction of the natural appearance of teeth. Each step of the process must be carried out with precision and attention to detail to ensure the success of the restoration.

DATA AVAILABILITY

All data analyzed during this study are available from the corresponding author upon reasonable request.

DISCLAIMER OF LIABILITY AND DISCLOSURE

All data analyzed during this study are available from the corresponding author upon reasonable request. The authors report no conflicts of interest regarding any of the products or companies discussed in this article.

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