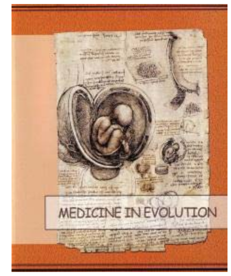
Characteristics of the technical steps required to obtain a ceramic restoration in the frontal and posterior area



Baciu S.[1], Burde A. V.[1]*, Grecu A. G.[1], Manole M.[1]

[1]Department of Propaedeutics and Aesthetic Dentistry, Faculty of Dental Medicine, "Iuliu Haţieganu" University of Medicine and Pharmacy Cluj-Napoca, Romania

Correspondence to:
Name: Manole Marius
Address: Clinicilor St, No. 32
Phone: +40 741040077
E-mail address: mnole22@yahoo.com

Abstract

Aesthetics is one of the main factors of success for a dental restorations. Nowadays patients claim more and more -besides longevity – to receive esthetic restorations that blend harmoniously with the surrounding teeth and tissues. The successful application of different all-ceramic materials is dependent upon clinicians' ability to match the ceramic materials to the manufacturing techniques and cementation or bonding procedures. The aim of our study was to present the technical steps for a special clinical case due to bruxism, for which the choice of restoration was metallic post-cores in order to insure optimal mechanical properties and with milled zirconia crowns.

Keywords: ceramic reconstructions, CAD-CAM, ceramic layering.

INTRODUCTION

Aesthetics is one of the main factors of success for a dental restorations. Nowadays patients claim more and more -besides longevity- to receive esthetic restorations that blend harmoniously with the surrounding teeth and tissues [1]. Ceramic reconstructions are gaining ground and are gradually replacing the PFM (porcelain fused to metal) restorations. Many clinical cases are complex and require the use of a core/framework which has an overwhelming influence on the prosthetic outcome. For a ceramic restoration, the greater the translucency of the core, the more the colors of the deeper layers of the tooth are transmitted to the surface [1]. When we use cores with high translucency, the reflected light will have the dominant color of the dentin, creating a natural-look. The translucency and color of a ceramic restoration depends on the various characteristics of the core and veneer ceramics [2]. The light which is passing through the ceramic layers is influenced also by the thickness of the ceramic layers to and by light scattering [3]. The last mentioned parameter is also depending on some factors, such as: refractive indexes of ceramic phase, voids and porosities, high number and size of the crystalline particles phase. Zirconia and alumina ceramics, are thus because of their high crystalline content, more opaque, but also more resistant to fracture [3].

Aim and objectives

The present case was selected for our study because of the specific clinical situation: teeth 1.4 - 2.5 with 4th degree abrasion with major aesthetic and functional changes. Due to bruxism, the choice of a restoration with high mechanical properties [3-10] was necessary. On the other hand aesthetics is also required due to the frontal-bicuspid area which needed restoring. Our decision was to use metallic post-cores for the restoration of the abutments, covered with milled zirconia crowns.

The successful application of different all-ceramic materials is dependent upon clinicians' ability to match the ceramic materials to the manufacturing techniques and cementation or bonding procedures, to adequately customize a treatment plan [11]. All ceramic systems have their contraindications and limitations. For example clinical situations with reduced interocclusal space, in case of nanic teeth, deep vertical overlap, excessive cervical-occlusal dimension of the teeth in the opposing arch, or severe bruxism or parafunctions have to be thoroughly analysed and are due to be resolved only by more resistant systems (such as zirconia) [12].

Although zirconia was used in orthopaedics during the late '60's, applications expanded only in the '90s in dentistry for endodontic posts, implants and implant abutments, orthodontic brackets, cores for crowns, and fixed partial denture prosthesis (FPDP) frameworks [13-15.] Strengthening of ceramic (e.g feldspatic ceramic) with other various materials started with Al_2O_3 and was followed by $Zr2O_3$ for reducing brittleness, crack propagation, improving low tensile strength, and wear resistance and marginal accuracy[16], [17].

Figure 1. a. initial state; b. reconstructed abutments; c. duplicated cast (after wax up and mock up); d. mock up

MATERIAL AND METHOD

First set of impressions used PVS and a study cast was made. Next, a wax-up was manufactured on the study cast, followed by duplication of the cast. The cast was sent in the office, were a mock-up was made, by using the Scutan technique. After obtaining the patient's consent, being satisfied with the aesthetic aspect, another set of impressions was taken. The full arch impressions were disinfected with Silosept and extra-hard type IV plaster (Klasse 4) was poured, using the Zeiser system to obtain the working cast.

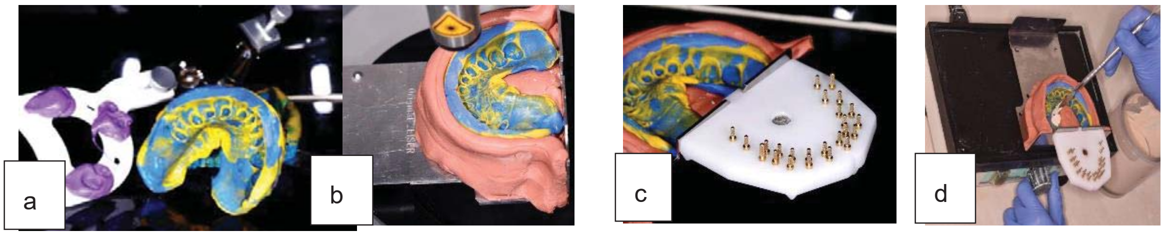


Figure 2. a. final impression of the upper arch; b.light spot projected in the impression of each abutment for marking and making the drills; c. Pins inserted into the pastic base of the future cast; d. Pouring plaster into the impression

An Amman Girbach Artex AG simulator was used for the mounting of the casts.

Figure 3. a. mounting the maxillary cast by means of the bite fork; b. upper and lower cast mounted into the simulator; c. digital impression; d. administrative data

Cutting the dies was not necessary at this stage, because a digital impression was also recorded by using a intraoral scanner (Omnicam, Sirona) and sent to the lab.

The patients data and treatment plan was inputed in the CAD software (Inlab 15.0, Sirona) before the scanning of the casts, namely the specification of abutments (1.1-2.2; 2.3, 2.5) and the types of frameworks: copings 1.1-2.2 /2.3-2.5 FPD (KATANA ZIRCONIA) and feldspatic ceramic layering.

After the initial scanning of the casts using a blue-light scanner (Sirona InEos X5), the working cast was edited by cutting off the parts that did not match our area of interest (Trim Model). By means of the registered occlusion, inter-arch relationships were checked so that necessary space for prosthetic restorations was provided. Next the alignment of the casts was made according to the midline of the upper and lower cast and, in the end, the curves of the arches were drawn and in respect to these lines, the position of each tooth was registered.

Figure a. edit model stage; b. checking of the occlusion; d. aligning the cast and establishing the model axis; d. drawing the curves of both arches and establishing the each tooth's position

The limit of the preparation was set with help of the draw Margin function. The insertion axis on all abutments was drawn so that to obtain as few retentive areas as possible. The Remove Undercuts function was used to eliminate the retentive areas where the milling machine cannot reach. Next, the actual design stage started by establishing the shape, morphology and size of the copings and framework according to the oral situation as well as the previously gathered data (providing enough space for layering, accordingly to the mock-up) (Fig 5).

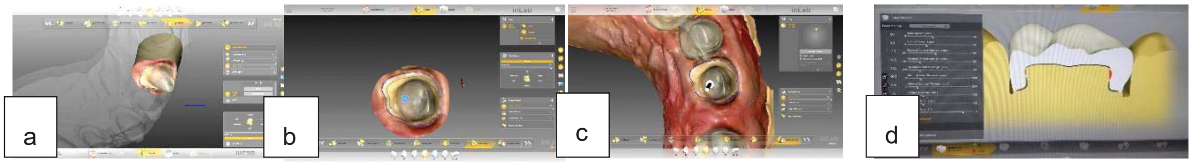


Figure 5. a. trim model function; b. drawing the preparation limit; c. drawing the insertion path of each abutment; d. setting the parameters of the restoration.

A vestibular reduction of 400 μ, 600 μ lateral reduction (in order to provide space for ceramic layering), luting cement space: 40 μ occlusal, 60 μ on the axial walls, and the minimum thickness of 700 μ was also established. The shape and parameters of the frameworks being set, the restoration was sent to a milling center. The chosen block was KATANA, Kuraray (Noritake company). Try-in followed and then the frameworks were sent back to the lab. (Fig 6).

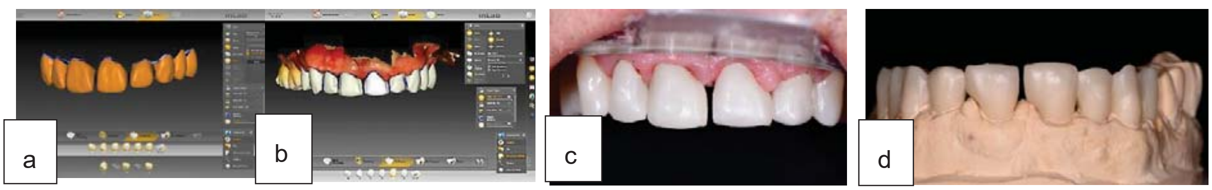


Figure 6. a. initial default morphology; b. buccal reduction for providing space for layering; c. try-in of the copings; d. copings on the working cast

It has been shown that the incidence of gingival inflammation increases around clinically deficient restorations, particularly those with rough surfaces, subgingival finish lines, or poor marginal adaptation. [15]. Because the central incisors presented a hypertrophic interdental papilla (mesial to 1.1 and distal to 2.1), the limit of the preparation was exposed by creating the access to the cervical area. Prior to the ceramic layering, ZirLiner was applied and sintered to enhance ceramic adhesion to the zirconia framework. Fracture of the veneering layers is the most common complication and needs complete restoration of the prosthetic construction [19][20].

A thin glaze film was applied onto the sub-structure and dentin powder (color A2) was then spread on the surface of the copings and bridge framework. Sintering was carried out at 950˚C.

In this stage, the individualization of the layers was done by internal staining. In the middle third A + dye was applied for an increased saturation and sintering was carried out. A2 dentin was used to restore the anatomical shape of the teeth, followed by cut-back for dentin reduction in the incisal third and modelling of the lobes. (Fig 7).

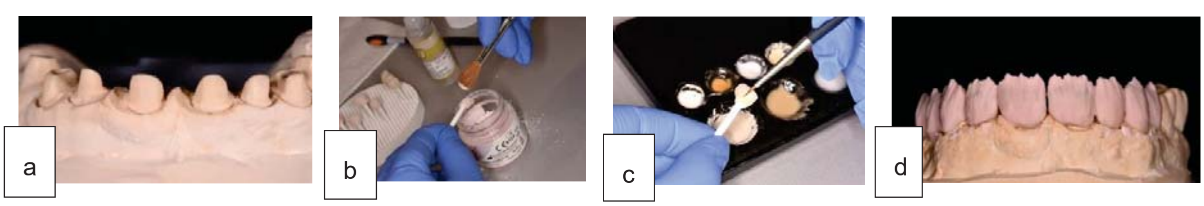


Figure 7. a. exposing the cervical limit by grinding the plaster of he gingival area; b. scattering dentin powder onto a thin glaze film for obtaining the foundation; c. internal staining; d. cutback of the dentin layer prior to sintering

After the aplication of the dentin, translucent and transparent enamel layers for increased light absorption have been overlayed between the lobes. On the incisal edges and the distal angles, a specific ceramic for reproducing the halo effect was used. In the areas of maximum convexity, ceramic paste which permits increased light reflection was applied and sintered, in order to enhance the brightness effect. The final effect was a controlled balance between light absorption and reflection. After sintering, a new layer of neutral ceramic was applied and sintered for rendering a natural effect of the veneering ceramics (Fig 8).

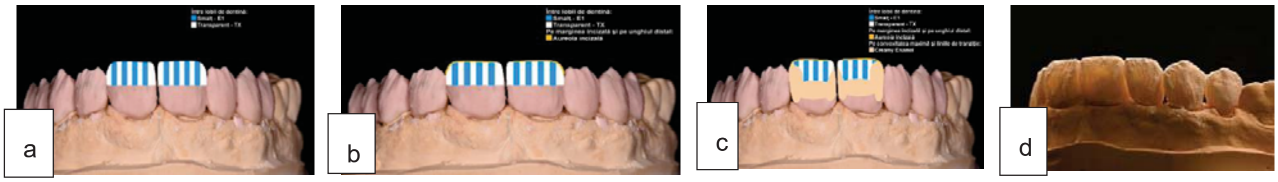


Figure 8. a. Enamel layer in the (incisal third); b area where halo effect is targeted; c. Alternative layering in the incisal third with Enamel E1, Transpatent TX, and Creamy Enamel for obtaining the halo effect; d. Restorations after correction and sintering

Finishing was achieved by using the hand-piece associated with diamond burs, stones and polishing wheels. The morphology re-contoured ensuring a clear landmark of the lobes and the transitional ridges, both vertical and horizontal, thus highlighting the limits of buccal surface. The aim of the micro-texture was to reproduce the growth centers and perikymata. By achieving this surface texture, a reflection of incident light similar to that of natural teeth was obtained. Manual polishing using various forms of abrasive diamond rubber was used to prepare the ceramic surface for glaze. The entire surfaces of the restorations were covered with an even glaze film. (Fig 9).

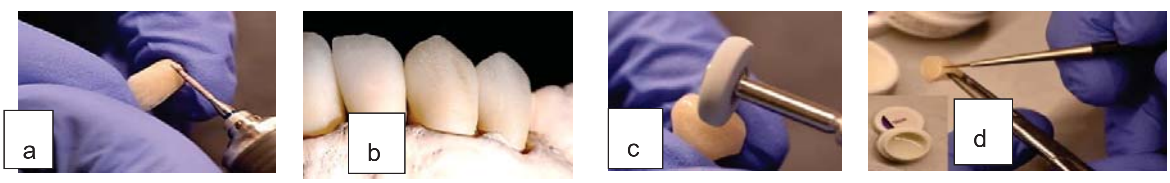


Figure 9. a. using diamond burs for micro-texture; b. details of the accomplished micro-texture; c. polishing; d. glaze film deposited with the brush

In the incisal third, the gray and blue stain was used to enhance translucency. In the cervical third stain A+ was used to enhnce the hue of these areas followed by sintering (Fig 10).

Figure 10. a**.** grayish blue in the incisal third and. stain A+ in the cervical third; b. Final aspect of the restorations on the cast; c,d. Final intra-oral aspect of the restorations

Polishing was conducted for a glossy effect, the most visible areas being the most convex ones, with a diminished texture, and on the flat areas were less shine is required, the micro-texture was enhanced. Sandblasting with 75 µ aluminim oxyde was used in order to obtain an internal clean surface, ready for luting.

CONCLUSIONS

Milled monochromatic restorations are more likely to achieve a lower degree of individualization, by comparison to the other ceramic techniques which do not require a core. The opaque porcelain required for masking a metal substrate is responsible for reflecting light and decreasing translucency. The chosen parameters for the milled coping (framework) and the space left for veneering will have a tremendous influence upon the final shade of porcelain restoration.

On the other hand, the use of multi-shade blocks, along with enough space to provide layering and a skilled technician to perform the ceramic layering, can obtain excellent aesthetic results that are also characterized by higher mechanical strength, compared to the previous mentioned techniques [4].

Zirconia ceramics are reported to have the highest mechanical properties (4)(21)(22). The strength of ZrO_2 ceramic frameworks makes them suitable to be used even in the posterior area, for multiunit FPDs [4], replacing thus in many cases the metallic frameworks required for PFM restorations.

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