CAD/CAM CHAIR-SIDE MATERIAL OPTIONS FOR ANTERIOR CROWNS

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ABSTRACT

Aim of the study. This article present today options for materials utilized with chair-side CAD/CAM technology. Selection of the most appropriate material for anterior crowns depends on each individual clinical situation.

Materials and methods. Dental ceramics and processing technologies have been significantly improved in recent years, offering to opportunities for different type of restorations. Classification of materials for chair-side CAD/CAM technology is based on different criteria, like microstructure, characteristics, cementation protocol. When anterior region is involved, which case is presented in this article, selecting the most convenient material and following the precise protocol, can lead to smile design enhancement.

Conclusions. Successful restorations of frontal teeth with CAD/CAM technology depends on good knowledge and understanding of the materials properties and clinical parameters, together with the precision of every step involved, from preparation, to scanning, designing, milling, to the final adhesive cementation.

Key words: *CAD/CAM technology, ceramic materials, anterior crowns.*

INTRODUCTION

Dental computer-assisted design and computer-assisted manufacturing (CAD-CAM) technology is widely used, as it reduces the number of clinical appointments and manufacturing time needed to produce esthetic ceramic restorations (1,2).

The CAD/CAM technology has several advantages over traditional fabrication, including reduced clinical times and increased productivity (3). 10 years ago there were just about 5 available materials for CAD/CAM technology, today there are over 30 different materials that can be chosen according to the type of each clinical case, starting from ceramic, composite, hybrid material and metals (4).

It is known that restorations made with chair-side CAD / CAM systems are monolithic, that means that the entire restoration is composed of one material, unlike of the bi-layered ones, which are formed from a core over which the veneer layer is applied (5).

Monolithic restorations have some unique features. Being industrial fabricated, they have a dense, homogeneous structure without porosity, which maximizes the physical properties of the material. They are delivered in the form of blocks with a mandrel specific for each milling machine. Milling machines use a substractive system (wet milling) to fabricate to the desired contour of the restoration, created by the digital design. After milling, depending on the characteristics of each material, it is allocated a certain amount of time and technique to complete the restoration (6,7,8,9).

Classification and characteristics of chair-side CAD/CAM ceramic materials

Materials for chair-side CAD/CAM technology are presented like milling blocks. According to Li &all, direct CAD/CAM ceramic materials can be classified in (3):

-direct CAD/CAM glass ceramics: feldspathic, leucite-reinforced, lithium disilicate, reinforced zirconium oxide and lithium silicate reinforced;

- direct CAD/CAM compatible polycristalline ceramics: zirconia.(3)

Glass ceramic, like silica based feldspathic materials, exhibit increased translucency, being the most aesthetic but less resistant ceramic materials. This category includes Vitablocs Mark (Vident), CEREC Blocks (Dentsply, Sirona), that are homogeneous feldspar ceramics with 4 microns particles. The small particle size allows perfect polishing and minimizes the wear-out (abrasion) effect on natural antagonists (10).

Leucite-reinforced ceramics, like IPS Empress CAD (Ivoclar) has about 35-45% leucite content, similar to IPS Empress1, but the particle size is less than 5 microns. The presence of the glass component in these materials allows them to be etched with hydrofluoric acid, treated with silane coupling agent and then bonded to the prepared tooth with resin cements (10,11).

Lithium disilicate ceramics, with the commercial name IPS e.max CAD (Ivoclar), consists of approximately 40% of 0.2-1 microns lithium disilicate crystals, and exhibits shear and fracture resistance much better compared to aesthetic ceramic materials (feldspar, leucite). Being presented in a partially cristalyzed phase (soft) allows for easier milling, after which the material has to undergo a process of completing the crystallization by firing in two stages in the ceramic furnace. A ceramic glass with approximately 1.5 micron grains and 70 volume percent of crystals is obtained in a glass matrix (12).

Zirconia-reinforced lithium silicate (ZLS) for CAD/CAM chair-side technology is produced since 2014 under two different products, Suprinity (Vita) and Celtra Duo (Dentsply). The structure consists in spherical particles of 400-500 nm zirconia that are infiltrated into the lithium silicate matrix (12,13).

After 2011 have been introduced nano-ceramic resins and hybrid ceramic materials, which have the advantage of composite, along with the ultimate strength and translucency of ceramics. Lava Ultimate (3MESPE) contains silicon particles of 20 nm, zirconium particles of 4-11 nm, about 80% ceramic load. There are currently nine different colors for this material and two translucencies (LT and HT). After milling, the restorations should be polish with suitable brushes and pastes and they can be bonded. In the early years of the launch, the indications were rather extensive, but now they were restricted to inlay /onlay restorations, and the

company 3MESPE has retired the indication for crowns.

From the category of nano-ceramic resins were recently introduced also other materials like: Cerasmart (GC), Shobu blocks HC (Shofu), Camouflage (Glidelwell), Grandio (Voco) (13). Resin-based composites are known with their superior aesthetics, ease of milling, simple intraoral repair techniques and less abrasive effect toward opposing dentition.

Another hybrid ceramic material is Vita Enamic (Vita, Germany) , which is composed of a double network structure in which the ceramic and the polymer are interconnected. According to the manufacturer, the material has the combined advantages of composites and ceramics in a single product, providing strength and elasticity, which gives the ability to prevent cracks. Ceramic network creates the basic structure and provides stability of the material, while polymeric network contributes to the elasticity. The shear strength is 170 MPa, which is relatively low. The milling time is much shorter (about 30%), but the adhesive cementation protocol ensures an increase in resistance. Vita Enamic has many advantages, including crack propagation, quality present in zirconia. However, there are some controversies about the use of these materials in areas with high concentration of stress (11,13).

Hard milling is for composite resins, hybrid materials and the following classes of ceramic materials: feldspathic, leucite-reinforced ceramic and lithium disilicate.

Regarding zirconia based materials, the strength and biomechanical characteristics recommend this class of materials for a large diversity of indications. Chair-side CAD/CAM zirconia blocks are yttrium tetragonal zirconia polycrystals (3Y-TZP) like pre- sintered blocks which after the soft-milling process are sintered at high temperature. For anterior crowns, it is recommended to choose the new class of cubic zirconia, ultra-translucent and super-translucent, but regarding blocks for chair-side CAD/CAM only one company produce this material and not for all milling machines (13).

Several advantages of CAD/CAM ceramic blocks were demonstrated, such as wear resistance, highly aesthetic appearance, biocompatibility, and color stability(1,11,15,16). Selecting the proper restorative material for anterior restorations is a challenge for the clinician, especially when the restoration will be fabricated with chair-side CAD/CAM technology, where the dentist takes the whole responsibility regarding the fit, shape and shade of the crown.

Step by step protocol for anterior CAD/CAM chair-side restorations

When dealing with smile design and anterior prosthetic restorations, a careful attention should be taken for the material selection. Chair-side CAD/CAM technology offer several solutions that combines resistance and esthetics.

A 15 years young patient with several esthetic issues presented in the Department of Prosthodontics for smile design rehabilitation. Clinical exo- and endo-oral examination and photographic and x Ray examination, reveal the presence of large decays and old composite filling in all four incisors (Fig.1).

After signing the informed consent and the agreement for publishing photos with the clinical case for scientific purposes, the treatment was accomplished in several appointments, beginning with the data analysis and assessment. The digital smile design was elaborated with Romexis Smile Design Software.

The selected treatment plan was: four ceramic crowns for the upper central and lateral incisors, after pre-prosthetic treatment, that consists in endodontic treatment for 1.1, 1.2, 2.1 and 2.2, followed by fiber post and core build-up from composite resin. After abutment preparation for

all-ceramic crowns (Fig.2), the digital impression was taken with an intraoral scanner (Planscan, Planmeca) and the digital model was obtained (Fig.3).

Figure 1.Patient smile at the presentation

Figure 2. Abutment preparation for all ceramic crowns

With the software Plan CAD easy was obtained the final design for anterior crowns and then were milled with the milling machine Planmill 40(Planmeca). The selected ceramic material was Empress CAD Multi, which is a polychromatic leucite- reinforced ceramic block that provides a balanced chameleon effect. (Fig.4)

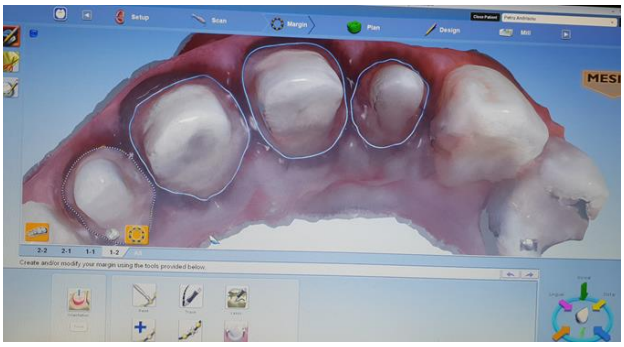

Figure 3. Digital model obtained after intraoral scanning

Figure 4. The milled crown from polychromatic leucite reinforced ceramic block Empress CAD Multi

After cutting the sprue, the milled crowns were glazed, without any other external characterization, due to the chameleonic effect of the selected ceramic block. (Fig.5)

Figure 5. The Empress CAD Multi crowns, with polychromatic effect after glazing

The adhesive cementation protocol was accomplished with Variolink Esthetic dual (Ivoclar), following the required precise steps. The final smile design improvement brought satisfaction to the patient and also to the doctor's team. (Fig.6).

Figure 6. The final smile of the patient, after adhesive cementation of Empress CAD Multi anterior crowns

RESULTS AND DISCUSSIONS

Choosing the most appropriate material to restore function and esthetics of the frontal teeth can be a challenging situation. An analysis of the laboratory and clinical data along with knowledge of the material structure can provide the foundation to make intelligent choices for given clinical situations (14,15,16,).

Silica-based feldspathic, leucite-reinforced, and lithium disilicate ceramics have high success rates for single-unit partial and full-coverage restorations. However, adhesive cementation is needed to maximize their outcomes (11,17).

For the anterior teeth crowns, there a many options regarding chair-side CAD/CAM blocks: from glass ceramics and lithium disilicate, to hybrid and resin nano-ceramics (8,12).

Optical properties of materials are very important when restoration of the frontal teeth is needed. Today CAD/CAM ceramic blocks are versatile and offer different options for harmonious esthetic integration adjacent to natural teeth, and polychromatic ceramic blocks for chair-side technology can be an adequate option with minimal post–milling individualization in order to obtain the biomimetic effect (9,10,17,18).

CONCLUSIONS

Proper selection of the materials and state of the art execution of all steps involved in chair-side CAD/CAM technology can lead to successful rehabilitation of the smile design.

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