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Update on the In ceram process

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ABSTRACT :

Ceramics constitute a large family of inorganic materials within the group of non-metals. They fall into three subgroups, silicate-based ceramics, oxide-based ceramics and oxide-free ceramics. As early as 1989, VITA began marketing the first material of the VITA In-Ceram all-ceramic system - VITA In-Ceram ALUMINA. Since then, the manufacturer has continued to develop new innovative materials within the framework of this concept. To date, prosthetists and dentists have a set of five very different materials for various processing methods. In this article, we will see the main features of this process for better use.

KEY WORDS : Ceramic, In ceram, Toughness, Aesthetics, Resistance

INTRODUCTION

For several years, the drawbacks of metal-ceramic systems and the increasingly important aesthetic demand on the part of patients have encouraged research to focus on metal-free restorations for the production of fixed single or multiple prostheses.

But the use of all-ceramic prostheses first comes up against a need to change certain habits in order to move in the direction of adhesive and aesthetic dentistry. The choice of a ceramic-ceramic technique brings many aesthetic, biological and mechanical advantages. In addition, these all-ceramic techniques require great rigor in the clinical implementation and their indication must be well defined. All-ceramic processes tend to multiply and the choice of a technique is currently difficult.

In this article, we will focus on the In ceram process, and establish the criteria for its reliability.

DENTAL CERAMICS

A ceramic is a material chemically composed of 99% oxides (with traces of fluorides), shaped from a powder whose consolidation involves solid or liquid phase sintering ". We can see that most ceramic materials used in dentistry are mainly glasses loaded with a crystalline phase in greater or lesser quantity. It would therefore be more accurate to use the term "vitreous ceramic" because the main constituent is an alkali aluminosilicate glass. The formation of microcrystals takes place at an appropriate temperature throughout the volume of the glass. These new glassy ceramics increase the strength of the ceramic and prevent the propagation of surface micro-cracks which, under load, propagate and lead to breakage.

THE IN CERAM PROCESS

In 1985, Mickaël Sadoun proposed a new ceramic-ceramic restoration process, derived from slip-casting; in 1989, it was marketed by the firm Vita under the name In-Ceram®. This process is used as one of the first alternatives to metal-ceramic restorations. It consists of the implementation in the laboratory of a slip serving to create a ceramic infrastructure which is sintered and then infiltrated with tinted glass. On this frame, which already contributes to the aesthetic result, a cosmetic assembly is then carried out.

Composition :

The development of a ceramic prosthesis according to this process uses two types of materials: a feldspathic ceramic weakly loaded with leucite, which represents cosmetic ceramic, and an underlying ceramic consisting of 85% by weight of alumina and infiltrated with glass. (15% by weight). In 1989, the addition of an alumina doped with 33% zirconia improved the mechanical behavior of the process (In-Ceram® Zirconia). On the other hand, the creation of In-Ceram® Spinell will increase the aesthetic properties of the process.

Mechanical properties :

Numerous studies have been carried out to determine the flexural modulus of rupture and the toughness of this type of ceramic; in fact, they are the ones which best reflect the mechanical properties. M. Sadoun, in 1995, gives a modulus of rupture of 580 MPa for In-Ceram® Alumina. In 1998, according to Ed Mac Laren, the flexural strength of In-Ceram® Alumina ceramic varied between 300 and 600 MPa while the spinel was at values 15 to 40% lower. In 1990, J. L. Ferrari, in his comparative study of toughness and fatigue parameters, obtained a value of 700 MPa for the flexural strength of In-Ceram ®Zirconia. R. Seghi and J. A. Sorensen, in 1995, give In-Ceram® Spinell a flexural strength of 350 MPa. Spinel therefore has lower mechanical properties compared to those of alumina. In general, a good number of studies show that the addition of zirconia improves the mechanical behavior of In-Ceram® ceramics, in particular, the toughness and resistance to fatigue.

Optical properties:

In the early days of the In-Ceram® process, the materials available were alumina, a unique infiltration glass, and for veneer ceramics the Vitadur® N ceramic created for Mac Lean's aluminous jacket in 1968. By developing other infiltration glasses in accordance with the Vitapan® classical shade guide, the process improves aesthetically, allowing the infrastructure to be adapted to the patient's tooth shade. The downside is that the presence of the aluminous infrastructure is involved in the final rendering. Indeed, it has the ability to impose its color through its relative opacity; that is, the transmitted light beam is attenuated. The use of spinel will improve the optical properties of this ceramic. However, there is a decrease in mechanical properties compared to the original In-Ceram® system. The aesthetic rendering of the In-Ceram® process is further improved thanks to the appearance, in 1998, of a new shade taking tool, the Vitapan 3D-Master® shade guide, which allows a more detailed and therefore more precise analysis of color, and which is based on the principle of colorimetry and on the three dimensions of color: luminosity, saturation and hue.

Accuracy of adaptation:

The In ceram process is characterized by its high precision of adaptation. It is the ceramic of the framework that makes the cervical adaptation; it is out of the question to find cosmetic ceramics at the level of the dento-prosthetic joint. So there is a peripheral band that supports the veneering ceramic, and the cervical fit accuracy of this band is 20 to 30 microns, which is the best fit ever achieved by any prosthetic system. This remarkable precision, associated with the recognized biocompatibility of glazed ceramics, allows the fabrication of aesthetic prostheses compatible with the preservation of periodontal integrity.

Operating procedure :

Due to the nature of its ionic bonds, which is at the origin of its optical, biological and mechanical properties, in particular fragility, ceramic resists well to work in compression and poorly in tension or shear. This is what led all the authors to recommend the realization of a shoulder with a rounded internal angle as a type of limit in order to support the material. In addition, this profile generates less mechanical stress than forms of preparations with sharp angles. The cervical limit is supragingival as far as possible, for obvious reasons of respect for the marginal periodontium and ease of implementation. This, however, can only be done if a translucent bonding material is used, and not having to mask dental discolouration at the joint. In this case, the limit would necessarily be intrasular in the visible areas. The depth of the cervical limit is determined by a double requirement: on the one hand, to provide a sufficient thickness of ceramic (fig. 1) for aesthetic and mechanical reasons, on the other hand, a concern for tissue economy for preservation pulp vitality. It is therefore a compromise between biological, mechanical and aesthetic constraints. The process must allow cosmetic assembly to a minimum in order to preserve the most massive possible screed, because it ensures mechanical strength, depending on the desired optical properties (fig. 2 and fig. 3). The ceramic coping is integrated into the cosmetic assembly by immediately approaching the base shade, and its translucency allows the reflection of light on the dentinal structures, or even enamel, of the prepared tooth. The preparation must be finished with a fine diamond bur or with a tungsten carbide bur, in order to perfectly polish the dental surfaces in order not to interfere with the removal of the impression and to facilitate the reading of the model on laboratory.

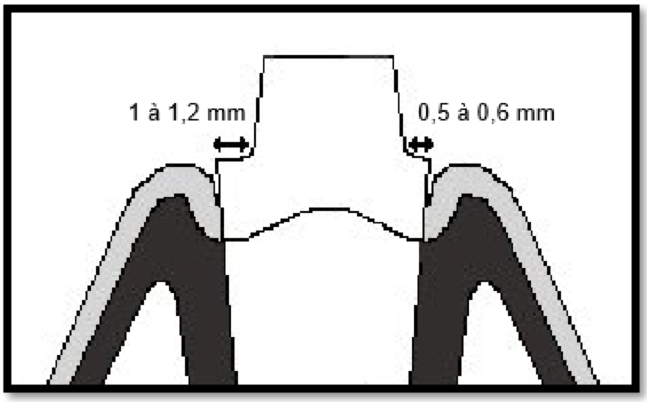

Fig.1 : Summary diagram of the preparation limits for a cement-retained anterior crown (In-Ceram® Alumina)

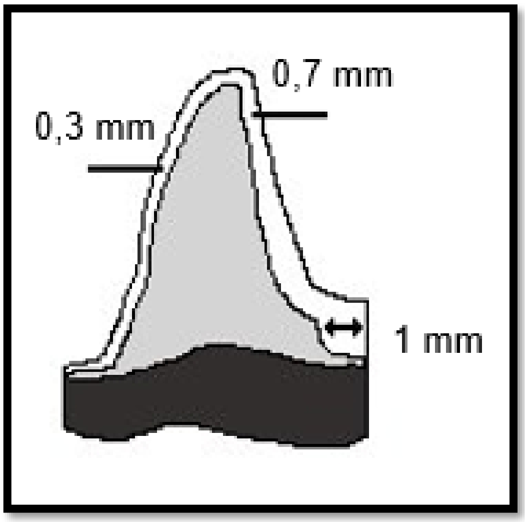

Fig.2 : Diagram of the ideal infrastructure of an In-Ceram® Spinell screed in the anterior sector

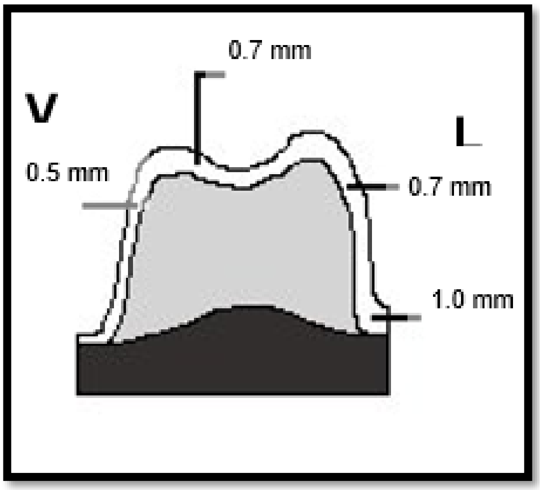

Fig.3 : Diagram of the ideal infrastructure of an In-Ceram® screed in the posterior sector

Choice of shade:

The shade is taken during the preparations since the infiltration glass of the screed contributes to obtaining the aesthetic result. Since 1998, a new shade-taking tool has been used for Vita products, including the In-Ceram® process, the Vitapan 3D Master® shade guide (fig. 4), based on the three dimensions of color: brightness, saturation and hue. The shade guide comprises 26 shades divided into five families of increasing luminosity (from very weak to strong), each of the five families comprises two to three samples of saturation and two to seven samples of different shades (M: medium, L: yellow, R: Red).

Fig.4 : The Vitapan 3D Master® shade guide

Realization of the infrastructure:

The ceramic-ceramicist will increase the shape of the homothetic infrastructure, which contributes to obtaining the shade, and reduce the volume of the covering ceramic. The model resulting from the impression is treated conventionally. A replica of each preparation is made in special Vita In-Ceram® plaster from an impression of the unitary positive model. The slip is then prepared: in a glass container, there should be 38 g of Vita InCeram® ALUMINA or ZIRCONIA Powder, 1 vial of Vita mixing liquid and 1 drop of additive. Mixing is done by placing the container alternately on the vibrator and then in the VITASONIC II® ultrasonic device. Finally, you have to put the slip for 1 minute under vacuum. For single crowns, each replica is then immersed in the slip which has the consistency of a thick paint. The plaster absorbs the water from the raw paste, promoting the agglomeration of the alumina grains. The morphology of this infrastructure is easily modifiable by adding a brush slip. For bridges, the application of the slip is done exclusively with a brush. The raw dough is left in the open air for 30 minutes and then the whole is dehydrated in an oven by raising the temperature to 120 ° C in 6 hours. The purpose of this maneuver is to dehydrate the plaster, which causes its retraction, favoring the separation of the screed from its support. After this dehydration, the whole is brought in 2 hours to 1100 ° C in an air atmosphere. This temperature is maintained for 2 hours. This firing corresponds to the sintering firing of the framework. For In-Ceram® Zirconia, a second sintering at 1180 ° C for 2 hours is necessary. The infrastructure then has a chalky consistency. The prosthetist can then correct the shape and function of the screeds by light grinding because after the glass has infiltrated, retouching will no longer be possible.

Infiltration of infrastructure:

Infiltration glasses, made of glass powder and distilled water, coded according to the principles of luminosity, saturation and color, make it possible to adapt the infrastructure of the crown to the multiplicity of colors, and fill the porosities of the 'infrastructure. There are 4 infiltration glasses for each process (In-Ceram® Alumina, Zirconia and Spinell). Using a brush, the prosthetist applies a covering layer of glass only on the upper surface of the screed and without covering the edges of the screed. The glass infiltration firing is done on a platinum rod for single crowns and on a platinum foil for bridges, the glass easily detaching from the platinum. The firing takes place according to the following protocol: - dehydration of the glass at 600 ° C for 5 minutes in a conventional ceramic oven; - the screed is then placed in the INCERAMAT® oven directly at 1100 ° C for 4 hours. For In-Ceram® Zirconia, this firing is done at 1140 ° C for 2.5 hours. The glass fills in the spaces left free by the grains of alumina. In case of incomplete infiltration, repeat the operation.

Removal of excess glass and inspection of the frame:

The excess is first removed with a coarse diamond abrasive and then the remainder is sanded with 50 micron aluminum oxide at a maximum pressure of 3 bar. The reinforcement is then checked in a scrupulous manner at the level of the lower surface and its adaptation to the model. It is necessary to detect the slightest defect liable to generate a crack.

Assembly of cosmetic ceramics:

The cosmetic ceramic must have a coefficient of thermal expansion equivalent to that of the ceramic used for the realization of the screed. Cosmetic assembly is reduced to a minimum since the framework is already in the chosen shade. This assembly is carried out in conventional thin layers in order to have low shrinkages. Two fires of Vitadur Alpha® or Vita VM7® ceramic are necessary to produce a functional biscuit.

Sealing or bonding:

In-Ceram® crowns can be cemented or glued. Cementation of In-Ceram® crowns is indicated in most cases (intrasular or juxtagingival limits); it is then done more with glass ionomer cements reinforced with resin known as CVI MAR or CVIH (Fuji plus®, Fuji cem®, Ketac cem® or Protec cem®) than with conventional glass ionomer cements. A surface treatment is necessary before sealing with glass ionomer cement. In fact, the passage of rotary instruments leaves the prepared surfaces covered with dentin mud, made up of milling debris and bacteria contaminated by oral fluids. Conditioning the surface with various acidic solutions, such as 10% citric acid for Fuji plus®, seems, in addition to a detergent action, to promote adhesion. When the limits are supragingival, one can choose the bonding; in this case, the In-Ceram® crowns are then bonded with a bonding composite (Panavia 21®) or a 4 meta resin (Super bond®, Morita) which is a chemo-activatable copolymer resin. Bonding allows the stress to be distributed throughout the restored tooth. Thus the mechanical strength of the assembly may prove to be greater than the intrinsic strength of each element constituting the assembly. The glue joint receives and transmits stress forces, but ideally it should be able to dissipate some of it. Dual or chemopolymerizable bonding materials are used because the photopolymerization alone is insufficient under the thickness of the ceramic. The specific treatment of the crown before bonding involves sandblasting the underside of the screed for 10 seconds to create a rough surface. Unlike other materials, alumina and zirconia are acid-fast and hydrofluoric acid etching of the underside of the In-Ceram® screed does not improve the micromechanical retention of the bonding polymer.

CONCLUSION

It is now accepted that the use of the In ceram process in the realization of anterior and posterior fixed prostheses is possible and safe. But the therapeutic success of this process depends both on the correct choice of its indications, on the bonding or sealing material as well as on the experience of the practitioner and the prosthetist. However, there are plenty of other all-ceramic processes. it is the duty of the practitioners to choose the most reliable procedures and having the most clinical hindsight, because there are products on the market which are not satisfactory and it is up to the laboratories as well as to the dental surgeons to make a effective research.

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