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Clinical Selection Criteria for Ceramic Systems in Aesthetic Restorations: Review and clinical case report

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Abstract

The prosthetic restoration of the anterior sector by all-ceramic systems often places the practitioner in a difficult situation where a wide choice of system is available.

The success of the choice of the all-ceramic system indicated to the clinical situation that the patient presents is based on the consideration of several factors such as the coloration of the abutment, the situation of the marginal limit and the occlusal stress ...

This article discusses the criteria for choosing ceramic systems according to the clinical situation imposed. A clinical case is presented to highlight the difficulties encountered during the restoration of the aesthetic sector on the one hand and on the other hand the importance of understanding the optical and mechanical properties of ceramics to meet the aesthetic demand of the patient

Keywords: ceramic, aesthetic, occlusion, abutment

Introduction

The rehabilitation of the anterior sector with ceramic restorations represents a real clinical challenge for the dentist due to the existence of a multitude of ceramic systems in today's market, as well as the increasing esthetic demands of patients who generally aspire to an ideal result despite the limitations imposed by the clinical situation.

Since 1903 Charles Land introduced the first full ceramic system using fired porcelain for inlays, onlays and crowns. At that time the lack of information on the conditions required for the survival of a biomaterial in the oral environment, poorly developed manufacturing techniques, as well as the inexistence of adhesive techniques led to the inevitable failure of this discovery.

Currently, the manufacturing techniques have undergone an important technological development, which has allowed ceramic systems to acquire over the years excellent mechanical and aesthetic properties.

The classification of ceramic systems has been established in the literature according to two criteria, the microstructure of the ceramic and their manufacturing methods.

Faced with the embarrassment of choosing between these different systems, their advantages as well as their

disadvantages, the dentist is obliged to choose a system adapted to the clinical situation and able to satisfy the aesthetic demands of the patient.

In this work a roadmap for treatment plans including anterior all-ceramic restorations will be presented, allowing the clinician to choose the appropriate system(s) for the clinical situation presented.

Tissue conservation and ceramic systems.

The development of bonding techniques has allowed the development of minimally invasive aesthetic and restorative dentistry, capable of satisfying the patient's aesthetic needs, respecting biological and mechanical principles and ensuring high clinical durability.

Ceramics can be classified into two categories [1]:

1. Vitreous phase ceramics:
- Vitreous ceramics or glass-ceramics
- Ceramics with glass infiltration
2. Ceramics without vitreous phase:
- Oxide ceramics (polycrystalline)
- High performance ceramics

Based on the principle of minimally invasive dentistry, the choice will always be made first for glass ceramics and secondly for crystalline ceramics. However, the clinical conditions presented by the patient may change the order of these priorities.

In general, aluminous ceramics and zirconia have better mechanical properties than glass-ceramics, while the optical properties of glass-ceramics are superior to those of zirconia. When used in their specific indications, both groups will show high performance with good aesthetic results and a minimal failure rate. (2)

Aesthetic considerations

For a successful aesthetic restoration two parameters will dictate the choice of system, the first of which is the desired position of the tooth on the arch and the second is the desired degree of shade change of the abutment or core build-up [2].

These two parameters will determine the thickness of the ceramic, since feldspathic ceramics, for example, will require a thickness of 0.2-0.3 mm per layer in order to mask the shade of the die, e.g. the thickness required for the transition from A3 to A1 is 0.9 mm. For pressed ceramics, a thickness of 0.8 mm is essential to achieve a satisfactory esthetic result. For milled ceramics, a thickness of 1.2 mm is required [3].

Taking these two parameters into consideration, a diagnosis based on tooth position and shade will guide the treatment plan to the most appropriate ceramic system for the clinical situation presented.

Clinical factors to be evaluated

Type of abutment

The first parameter to be assessed is the type of substrate on which the all-ceramic crown will be placed. This parameter will influence the selection of the ceramic system depending on the shade and translucency of the preparation and the method of cementation indicated in this case.

Several situations may be present, the first is when the substrate is dental tissue, at this point the composition of this tissue and the color must be investigated to determine whether the enamel completely or partially covers the tooth, or whether the substrate is dentin, in which case the nature of the dentin must be investigated, since sclerotic and tertiary dentin have a low bonding potential.

In the second case where the abutment is represented by a biomaterial (composite, ceramic or metal). The choice of system will be made on the basis of the translucency of the restoration in the first instance as well as on the assembly method indicated for the clinical situation.

If the material is a reconstitution composite or a ceramic, the indicated system can be chosen from the translucent systems. (Pressed and feldspathic ceramics)

If the material is metal then the choice will be directed towards an opaque system capable of blocking out the effect of the alloy and in this case zirconia can be indicated.

Para functions

A careful oral examination should be performed to look for wear on healthy teeth as well as on dental restorations. Signs of significant parafunction may be, excessive enamel wear, tooth or restoration fracture, and loss of seal at the level of the fillings. Often the etiology of these para functions is multifactorial and controversial. [4]

The presence of this syndrome should help the practitioner to preview the environmental conditions in which the ceramic restoration will be used and guide him in the selection of the most appropriate ceramic system to resist the stress generated by this syndrome and thus ensure the durability of the aesthetic restoration over time.

Furthermore, bruxism does not appear to be a risk factor for all-ceramic restorations [5]. Flexural and shear bond strength

The third parameter is the degree of stress occurring in the ceramic restoration as a result of tensile and shear forces; all types of ceramics have a low degree of tolerance to this type of stress, in contrast to the compressive forces which the ceramic can withstand well [6]. These forces are generally generated by masticatory movements when there is a significant overbite. Three situations arise:

- If the stress generated by these stresses is low, low-strength ceramics (Vitro-ceramics) can be used [7].
- If the level of stress is moderate, a compromise situation can be proposed: a high-strength ceramic substructure on which feldspathic ceramics will be layered will absorb the stress and convert it into a compressive force, the same concept as the metal-ceramic crown [8].
- In case of high stress, crystalline ceramics will be indicated [7].

Discussion

Modern Prosthodontics is currently undergoing a real technological revolution in relation to the appearance of new biomaterials such as new ceramics on the one hand and new techniques such as CAD/CAM on the other.

Currently, glass-ceramics (Empress, Vitablocs mark II and Authentic) are indicated for the restoration of anterior teeth and occasionally for premolars, this system is preferred in cases where the restored tooth(s) contain enough enamel tissue for bonding and are not subject to significant mechanical stress [9, 10].

They are suitable for anterior crowns and veneers, as well as posterior inlays and onlays. This type of ceramic can withstand moderate shear and tension forces. IPS Emax, which belongs to the glass-ceramic family, represents a new generation which is characterized by high strength and excellent esthetic properties. This system retains the same indications of the glass-ceramics in addition to its indication in the single-tooth restoration of a tooth undergoing severe occlusal stress [11].

Finally, high-strength crystalline ceramics such as zirconia are indicated in cases where the tooth(s) to be restored show significant structural loss with the presence of an unfavorable stress balance, as well as in cases where adhesive bonding is not indicated in preparations with subgingival margins [12, 13].

Clinical case

The patient is a 40-year-old woman in good general health who attended the department of fixed prosthodontics at the Rabat University Hospital. The main reason for consultation was the unsightly appearance of

the crowns at 21 and 22, and the diastema between 11 and 21.

Intra-oral examination of the abutment teeth revealed the presence of 2 unsuitable metal-ceramic crowns with a large over-contour, a metal inlay-core on 22, and generalized marginal gingival inflammation.

The occlusal examination shows a stable IOM, propulsion is ensured by the central and lateral incisors.

The proposed treatment plan was based on the removal of the old crowns and periodontal debridement. Prosthetically, an all-ceramic restoration in the form of two zirconia substructure crowns with feldspathic ceramic layering and a feldspathic veneer on 11 was chosen.

This ceramic system was chosen in order to take advantage of the opacity of the zirconia on the one hand to mask the metal abutment as well as the dental discoloration on the 21. On the other hand, zirconia offers better stress resistance to the restoration.

The layering of the feldspathic ceramic on the zirconia substructure provides an aesthetically pleasing result.

The veneer on 11 will harmonize the esthetics of the shapes and shades and help to reduce diastema.

The subgingival position of the cervical margin is an indication for cementation, which eliminates the possibility of choosing a ceramic system that is assembled exclusively by bonding (vitreous ceramics). The restorations on 21 and 22 were cemented using an adhesive cementation technique. The veneer on 11 was bonded using a Dual Bonding Composite.

Figure 1: Initial situation

Figure 2: Presence of different types of substructures 11: Vital tooth 21: Root canal treatment with dental abutment 22: Metal abutment (inlay-core)

Figure 3: 11: Dental preparation of the veneer 21 and 22: Checking the zirconia infrastructure fitting

Figure 4: Final situation after bonding the veneer and cementing the crowns.

Conclusion

Successful selection of the ceramic system in the anterior region depends on understanding the limitations and indications of each system and the correct use of new design and fabrication techniques.

The clinician should use the biomechanical principles of each type of ceramic to ensure the durability of ceramic restorations in the aesthetic areas and to prevent failures as much as possible.

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