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Clinical Technique/Case Report

Ceramic Fragments and Metal-free Full Crowns: A Conservative Esthetic Option for Closing Diastemas and Rehabilitating Smiles

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Clinical Relevance

The reestablishment of the anterior teeth's esthetic harmony can be obtained with excellent clinical results by using the same porcelain for different tooth preparations, such as for laminate veneers and full metal-free crowns.

SUMMARY

Dental ceramics make it possible to restore anterior teeth that have been esthetically compromised, presenting a high resistance to wear, biocompatibility, color stability, and low thermal conductivity. The development of different types of ceramic and techniques for adhesive cementation have made it possible to produce more conservative restorations without involving the healthy dental structure and with minimally invasive preparation, such as the bonding of ceramic fragments. The purpose of this article is to describe a clinical case in which diastemas were closed by using nanofluorapatite ceramic (e.max Ceram, Ivoclar-Vivadent) fragments on teeth 7 and 10 with minimal tooth preparation and metal-free ceramic crowns (e-max Ceram) reinforced with zirconia copings through a computer-aided design/computer-aided manufacturing system (Lava, 3M-ESPE) on teeth 8 and 9.

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INTRODUCTION

A harmonious and attractive smile gives back a person's self-esteem and allows for a more favorable first impression. The smile is a person's most important facial expression, and the anterior teeth are the most direct complement to this harmony.[1]

The advent of new ceramic materials has led to a greater demand for their use as they enhance biometric qualities such as enamel structure, biocompatibility, longevity, mechanical strength, and chemical stability.[2] In some situations where the dental structure is absent or has little coronal structure remaining, it may be necessary to recommend a crown. One can consider metal-free crowns to obtain a better esthetic, using reinforced ceramic (with alumina, zirconia, or lithium disilicate, among others), which provides more mechanical strength.[3]

Laminate veneers are also commonly suggested for reestablishing the cosmetic shape of the teeth, to close diastemas and correct dental alignment, or to produce small alterations in color.[4] The use of laminate veneers was made possible once a technique was developed to treat ceramic with hydrofluoric acid, in combination with the application of a bonding agent (silane), to obtain an adhesive interface with resin cements[5] after conservative tooth preparation.[6] However, in situations where the teeth are healthy there is no need to carry out dental preparation. There is only a need to correct dental alignment or to correct the shape, form, or harmony of the smile when the person has diastemas. In these cases, refractory feldspathic porcelain or pressed ceramics are used to build ceramic fragments. These fragments, by way of an adhesive cementation technique, are bonded to the dental structure through resin cementation systems, allowing such fragments to resist fracture.[7]

However, in some clinical situations it is necessary to use different ceramic restorations on the same person, such as fragments, laminate veneers, and full crowns. Use of different types of restorations can present different degrees of translucency and opacity and may compromise the esthetic results of the ceramics.[8]

Thus, the objective of this article is to present a clinical case in which ceramic fragments and metal-free full crowns were used to close diastemas and reestablish the shape and esthetics of the upper anterior teeth with the same type of ceramic (e-max Ceram, Ivoclar-Vivadent, Schaan, Liechtenstein).

Figure 1. *Anterior teeth, frontal view.*

CASE REPORT

A 38-year-old woman presented with a chief complaint of diastemas between her upper central incisors and between the central incisor and the lateral incisor on the right side (Figure 1). The patient stated that she had had a dental implant in the right central incisor region and a ceramic crown made approximately 15 years ago. The left central incisor presented a class IV resin restoration with staining, loss of translucency, wear, and the presence of microinfiltration. The patient wished to improve the esthetics of her anterior teeth and close the diastemas.

Good oral hygiene was observed during the clinical exam. Periodontal examination revealed no gingival inflammation or bleeding during probing. The patient's medical history presented no contraindications to dental treatment.

After the clinical examination, impressions were made of both arches using stock trays and irreversible hydrocolloid (Hidrogun, Zhermack, Badia Polesine, Italy) and poured in type IV cast stone (Kromotypo4, Lascod, Firenze, Italy).

The upper cast was used for diagnostic wax-up and then duplicated. The diagnostic wax-up and the duplicate cast were presented to the patient, and the treatment plan was discussed. It included two metal-free full crowns in ceramic reinforced by zirconia copings for the upper central incisors and two ceramic fragments with a nanofluorapatite ceramic base for the upper lateral incisors.

An impression with condensation silicone material (Speedex, Coltene-Whaledent, Altstatten, Switzerland) was obtained using an aluminum impression tray from the duplicate cast of the diagnostic wax-up. This stone cast was later used to simulate the final result of the proposed treatment using self-

Figure 2. *Mock-up of the patient's mouth using self-polymerizing acrylic resin.*

polymerizing acrylic resin in color 62 (Snap Parkell, Edgewood, NY, USA) (Figure 2). After the patient approved the esthetic result, the teeth were prepared and the impression was made using a vinyl polysiloxane material (Elite HD, Zhermack) (Figure 3). To improve the esthetic condition, a computer-aided design/computer-aided manufacturing system was used to fabricate the coping for the central incisors using zirconia (Lava System, 3M-Espe, St Paul, MN, USA). The Ceramic was then fired over the copings to make the crowns (e.max Ceram, Ivoclar-Vivadent, Schaan, Liechtenstein). The ceramic fragments were made with the same nanofluorapatite ceramic base (e.max Ceram, Ivoclar-Vivadent) (Figure 4).

For final cementation, self-conditioning resin cement (Rely X U100, 3M-Espe) was used for the metal-free crowns in the upper central incisors under rubber dam isolation.

The ceramic fragments were conditioned with 9.5% hydrofluoric acid (DMG, Hamburg, Germany), two layers of silane were applied (Monobond-S, Ivoclar-Vivadent), and finally the adhesive application (Bond, 3M-ESPE) was carried out. On teeth 7 and 10, conditioning with phosphoric acid at 37.0% (Bisco Inc, Schaumburg, IL, USA) was performed and, after abundant water rinsing, an enamel adhesive was applied (Bond, 3M-ESPE). The cementation was done with a resin cement's base paste (Variolink II, Ivoclar-Vivadent) which was photoactivated for 40 seconds (Figure 5). The final presentation can be seen in Figures 6 through 8.

Figure 4. *Anterior teeth: ceramic fragments on teeth 7 and 10 and metal-free crowns on teeth 8 and 9.*

DISCUSSION

For a smile to be considered esthetically attractive, there must be a harmonious balance between shade, shape, and texture. With the objective of correcting a lack of esthetic harmony in the smile, such as with conditions like diastemas, peg teeth, and alterations in color and tooth size, ceramic restorations have frequently been used.[9]

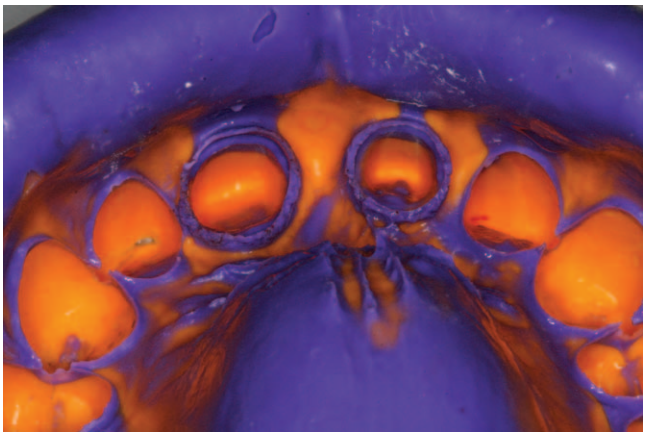

Figure 3. *Impression made using addition type silicone.*

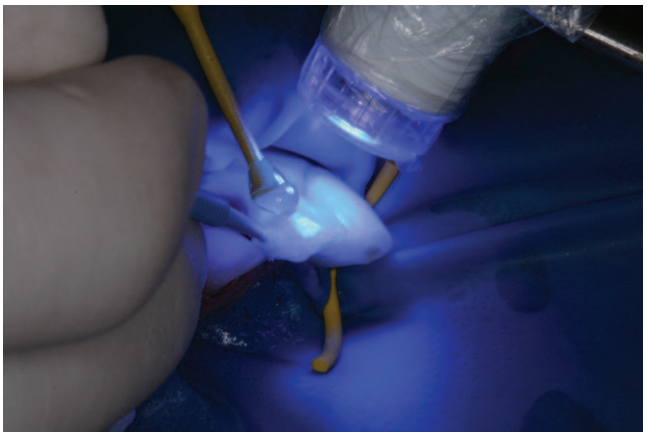

Figure 5. *The resin cement paste after photoactivation on tooth 7.*

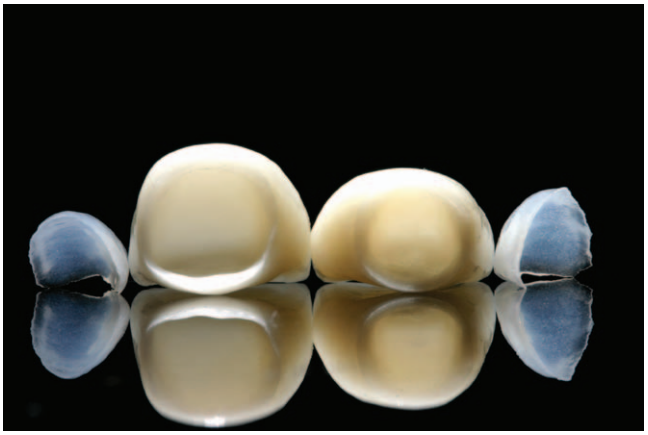

Figure 6. *The translucence of the ceramic fragments and the metal-free crowns.*

Composite resins were traditionally used to correct and close diastemas and to improve teeth with shade alterations. However, because of their low clinical longevity and susceptibility to pigmentation problems and marginal fractures, professionals have opted for laminate veneers and ceramic fragments.[10,11] Ceramic fragments present a low occurrence of loss of adhesion and fractures[10,11] and possess a mechanical strength similar to that of the natural tooth.[12] Because of this, we decided to make ceramic fragments for teeth 7 and 10 so as to preserve the remaining dental structure.

Piemjai and Arksornnukit[13] measured the resistance to compression of laminate veneers of 0.5 and 1.0 mm thickness when bonded to the enamel and to the dentin using different resin cements. They observed similar results between the self-polymerizing and photoactivated cements when cemented

Figure 7. *Anterior teeth after treatment.*

Figure 8. *The final presentation, a natural smile.*

in enamel. In this case, we opted to use a photoactivated cementation system, which has the advantages of greater clinical longevity, greater bonding strength due to the substrate being enamel, and non-alteration of cement color over time; in addition, because the ceramic fragments are very thin (0.3mm), they allow for adequate transmission of light and polymerization of the resin cement.[13]

For the upper central incisors, we decided to make metal-free crowns because of the implant present in the region of tooth 8 and because there was little remaining coronal structure in tooth 9. The advantage of crowns made with zirconia copings by the CAD/CAM system is that they have good mechanical strength and are more opaque; because of this, they are recommended for teeth that have color alterations or a metallic substrate.[14] However, because they are acid resistant, it is not possible to use adhesive cementation. Thus, we decided to use a self-adhesive cement, taking into consideration the fewer number of clinical steps for this procedure. Moreover, this cement combines with the hydroxyapatite of the dental substrate (for tooth 9) which does not promote the formation of a hybrid layer, and provides adequate bonding strength to the zirconia infrastructure.[15]

The use of different ceramic systems in an extensive restorative treatment can compromise the final result in terms of the ceramic shade and translucency. Because of this, in this clinical case we opted to use the same ceramic (e-max Ceram) for the fragments (teeth 7 and 10) and for the covering material in the zirconia copings (teeth 8 and 9), thereby gaining a very satisfactory esthetic result.

CONCLUSION

The demand for a beautiful smile is a reality, and the use of ceramic fragments with a nanofluorapatite ceramic base and full crowns in ceramic reinforced with zirconia can restore the esthetics via a very conservative and minimally invasive restorative treatment.

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Conflict of Interest

The authors of this manuscript certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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