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Repairing Ceramic Restorations: Final Solution or Alternative Procedure?

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PURPOSE

This article provides an overview of dental ceramics. It addresses possible modes of failure and factors that may influence the decision to either repair or replace ceramic restorations. The authors' intention was to present ceramic repair as a reliable, low-cost, low-risk technique.

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INTRODUCTION

Feldspathic ceramic, also known as conventional or traditional ceramic, was one of the first dental ceramics used for the fabrication of full ceramic crowns. This material required the use of a metallic framework (copping) to offer support and provide resistance to the prosthetic structure. Though this first generation dental ceramic had good esthetic qualities, it increased wear to the opposing tooth and was extremely difficult to fabricate.

Over time, ultra-low fusing porcelains were developed. These porcelains offer reduced sintering time, reduced deformation of fixed partial denture frameworks due to creep at high temperatures and less wear of the opposing tooth's enamel.

With the introduction of the concepts of adhesion and reinforced ceramics, the fabrication of all-ceramic fixed dentures became possible. These dental porcelains were developed with the goal of controlling the propagation of cracks formed during the laboratory phase or in the clinical setting. Current materials for all-ceramic restorations are reinforced with the addition of a variety of crystalline phases to the restorative mass, such as leucite, alumina and zirconia.

Reasons for failure of dental ceramics include contamination during fabrication, incorrect planning, endodontic factors and esthetic failure, often due to crown margin exposure from gingival recession.[1-3]

An esthetic and functional repair, wherever possible, has many advantages over time-consuming, expensive remakes of ceramic crowns and/or bridges.

DESCRIPTION OF THE TECHNIQUE

Treatment of Ceramic Surface

Removing the glazed ceramic layer is suggested in order to allow for exposure of an underlying ceramic layer that is more reactive and has a greater contact surface area. The ceramic surface may be prepared mechanically, chemically or with a combination of both methods.

Roughening with Diamond Burs: Pameijer and others[4] and Kussano and others[5] have reported that the roughening of a porcelain surface with diamond burs alone yields lower adhesion values than other surface treatment methods. However, when associated with other procedures, this technique is essential in the preparation of ceramic restorations to be repaired. Diamond bur roughening should be performed at high speed to avoid the vibration of low-speed handpieces, which would produce cracks and fissures at the ceramic margins.

Sandblasting: The sandblasting of ceramic surfaces that are to be repaired is usually performed with a high-speed stream of purified aluminum oxide particles (30-250 µm) delivered by air pressure (2 to 3 bar or 30 to 42 psi) for approximately 15 seconds. Care should be taken to avoid injuries to the surrounding soft tissues as well as control the emission and spread of aluminum oxide particles over the operative area. This can be accomplished by using rubber dam isolation and high-power suction systems, respectively.[2,6-8]

Acid Etching: The use of etchant agents is not limited to dental ceramics; it is also part of the adhesion protocol. Acid etching yields a clean surface and produces micro-retentions that increase bond strength of the etched substrate. Three acid formulations may be used for the surface treatment of dental porcelains: a) 37% phosphoric acid; b) hydrofluoric acid and c) 1.23% acidulated phosphate fluoride.

a) 37% Phosphoric Acid: While this acid does not produce any type of alteration to the ceramic morphology, it may be used for surface cleaning after mechanical roughening. It is used where there is associated dental structure and does not pose risks to the oral soft tissues.[5,9-10]

b) Hydrofluoric Acid: This acid acts on the silicon dioxide (SiO_2) of the porcelain vitreous phase, especially feldspathic, thus creating surface irregularities. Etching time ranges from 20 seconds to 10 minutes, depending on the type of ceramic, and should follow the manufacturer's recommendations. The concentration of hydrofluoric acid may vary between 5% and 10%. One

Figure 1. *Case 1: Initial view.*

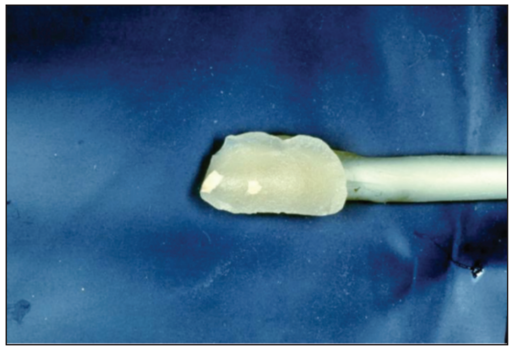

Figure 2. *Case 1: Ceramic fragment.*

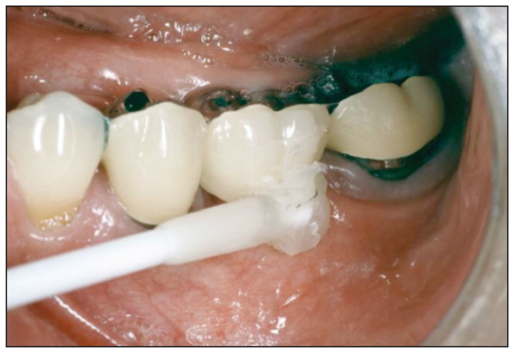

Figure 3. *Case 1: Evaluation of the fragment fitting.*

Figure 4. *Case 1: Modified rubber dam isolation.*

Figure 5. *Case 1: Phosphoric acid etching, after roughening with diamond bur.*

Figure 6. *Case 1: Ceramic fragment etched with hydrofluoric acid.*

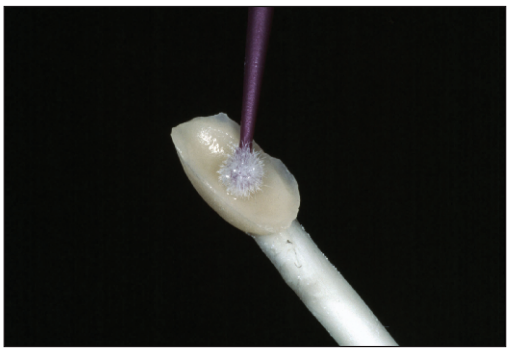

Figure 7. *Case 1: Silane and Bonding agent application.*

Figure 8. *Case 1: Completed restoration.*

Figure 1. *Case 2: Initial view.*

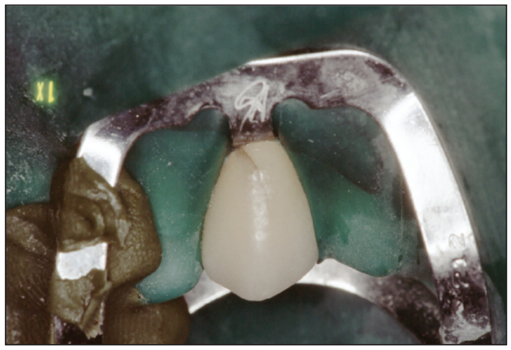

Figure 2. *Case 2: Rubber dam isolation.*

Figure 3. *Case 2: Aspect of the roughened surface by diamond bur.*

Figure 4. *Case 2: Ten percent hydrofluoric acid etching.*

Figure 5. *Case 2: Opacifying agent application, after silane and bonding agent application.*

Figure 6. *Case 2: Final restoration with layered resin composite.*

of the disadvantages of this acid is its aggressive treatment of human tissues. Several studies have demonstrated the efficacy of its use on the surface treatment of dental ceramics.[5-6,9-16] However, a consensus has not yet been reached regarding its indication, as similar outcomes to those obtained with hydrofluoric acid have been reported with other surface treatment methods.

c) 1.23% Acidulated Phosphate Fluoride: The effect of acidulated phosphate fluoride on the ceramic surface is similar to that produced by hydrofluoric acid. It attacks the glass, probably due to the selective release of sodium ions, interrupting the silica network. A concentration of 1.23% should be used in the treatment of dental porcelains. Etching time varies from 5 to 15 minutes. The main advantage of this acid agent is that it is innocuous to the oral tissues.[13,17]

Silanization: The use of silane agents in the adhesive protocol of ceramic restorations improves the chemical union between porcelain and resin luting agents. Silane consists of a carbon chain that presents an SiO_2 group in a functional end. Silane has a priming effect on the ceramic surface and is applied prior to the adhesive agent. This joins the functional end, which possesses the silicon, to the porcelain, thus maintaining the carbon chain free for bonding to the resin. The silane is an adjuvant agent that improves the union to the porcelain

Figure 1. *Case 3: Initial view.*

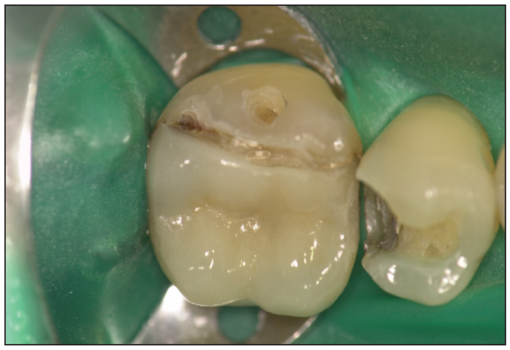

Figure 2. *Case 3: Rubber dam isolation, enamel and ceramic roughening.*

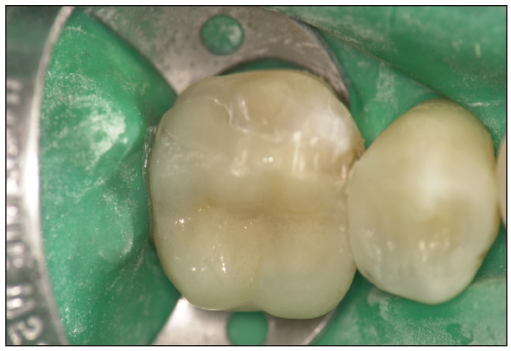

Figure 3. *Case 3: After adhesive procedures and placement of the resin composite.*

Figure 4. *Case 3: Completed restoration, after occlusion checking.*

and should be used in conjunction with other surface treatments (roughening with diamond burs, sandblasting and/or acid etching) and the adhesive system. Silanization is a key step in the adhesive protocol of dental ceramics. There are no reports of disadvantages and its bond strength substantiates its indication.[4,9,14,16,18-20]

RESTORATIVE MATERIAL

Glass Ionomer Cement: This may be used for ceramic repairs in porcelain fused-to-metal restorations due to its ability to bond to both metal and composite materials. This material is opaque and can be matched to a variety of tooth shades. Its characteristic of local fluoride release presents the advantage of increased resistance to the onset of carious lesions.

Resin Composites: Because of their physical, mechanical and optical properties, hybrid resin composites and their variations are best suited for ceramic repairs. Resin composite systems that offer opaque and translucent resins, in addition to the basic shades, should preferably be used to reestablish esthetics after ceramic repair.[2,4,18,20-22]

POTENTIAL PROBLEMS

Intraoral repairs present a wide range of difficulties inherent to clinical treatment. These difficulties include the need to explain to the patient the causes of restoration failure and the challenge of anticipating the longevity of the repaired restoration. Additionally, ceramic repair fundamentally depends on an adequate adhesive protocol, which, in turn, depends on the physical and mechanical behaviors of very different materials. Finally, the use of high-speed diamond burs and acid etchants close to the gingival tissue requires special care to avoid injury.

SUMMARY OF ADVANTAGES AND DISADVANTAGES

The repair of fractured ceramic restorations with resin composite has some major advantages, as it preserves the main body of the restoration, avoids unnecessary reduction of sound tooth structure, is an inexpensive procedure and makes treatment feasible in an easier, faster manner. Disadvantages include anticipating the longevity of the ceramic repair and handling difficulties in the operative field.

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