

# CERAMIC RESTORATION REPAIR: REPORT OF TWO CASES

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## ABSTRACT

The esthetic and functional rehabilitation of patients with multiple missing teeth can be performed with several techniques and materials. Ceramic restorations provide reliable masticatory function and good esthetics. However, fracture can occur in some cases due to their brittle behavior. In some cases, the replacement of an extensive prosthesis is a problem due to the high treatment cost. In this paper, two cases are presented, in which fractures occurred in extensive metal-ceramic fixed partial dentures, and their replacement was not possible. Ceramic repair was chosen and the sequences of treatment with and without presence of the ceramic fragment are also discussed. The cases illustrate that, in some situations, fractured metal-ceramic partial dentures can be successfully repaired when prosthetic replacement is not a choice. Prosthodontists must use alternatives that allow a reliable repair to extensive metal-ceramic fixed partial dentures. Surface preparation of the ceramic with hydrofluoric acid in conjunction with a silane coupling agent is essential for a predictable bonding of composite resin. The repair performed with composite resin is an esthetic and functional alternative when extensive fixed partial dentures cannot be replaced.

**Key words:** Dental prosthesis repair. Dental porcelain. Composite resins. Case reports.

## INTRODUCTION

Ceramic and metal-ceramic restorations have been used for several decades by clinicians to provide esthetics and masticatory function<sup>2</sup>. Studies have shown various advantages of the ceramics, like color stability, radiopacity, coefficient of thermal expansion similar to that of dentin, good compressive and abrasive resistance, and esthetics<sup>1,14</sup>. However, dental materials and adhesive interfaces are subjected to stress in the oral environment: masticatory forces, temperatures changes, saliva and pH changes<sup>11</sup>. Moreover, trauma and fatigue can cause fracture of the ceramic or destroy the ceramic-metal bond<sup>14</sup> because this restorative material has a low tensile strength and a high modulus of elasticity with a brittle behavior<sup>1</sup>.

Problems such as a high treatment cost, possible trauma to the restored tooth, difficulty of removing the restorations, and patient demand for a rapid case resolution, may occasionally delay the replacement of a fractured metal-

ceramic restoration<sup>15</sup>. Intraoral repair of fractured ceramic restorations with composite resin restorative materials presents a substantial challenge for clinicians<sup>9</sup>, and is also a viable alternative for patients because these restorations are difficult to remove<sup>2</sup> and very expensive to be replaced<sup>14</sup>. Numerous repair systems are available for recovering of ceramic fractures<sup>2</sup>. The techniques include surface preparation of the ceramics and silane treatment in the bonding procedure<sup>9</sup>.

The establishment of reliable and durable chemical bonds between dental ceramics and composite resin is of paramount importance<sup>3</sup>. With the introduction of silane coupling agents, a durable solution to ceramic repair became possible, since these hybrids inorganic-organic compounds bond dissimilar materials, organic and inorganic, together<sup>11</sup>. The bond between ceramic surface and composite resin can be created with hydrofluoric acid etching for generation of a micromechanically retentive surface and silane agents. A combination of sandblasting and hydrofluoric acid would

produce the best surface for composite resin repair, however hydrofluoric acid alone can be considered adequate when preparing a ceramic surface<sup>14</sup>.

Thus, dental professionals should use techniques that produce acceptable, simplified, low cost and quick repair of such restorations. This paper presents two cases of feldspathic ceramic repair using composite resin, with and without the fractured ceramic fragment, in a single clinical session without the need for laboratorial assistance, allowing for an esthetic and functional rehabilitation.

## CASE REPORTS

### Case 1 - Ceramic Repair without Ceramic Fragment

A 45-year old female patient with a 9-unit metal-ceramic fixed partial denture presented with a fracture delamination of the buccal and part of the incisal surface of the maxillary left central incisor distal angle without the ceramic fragment (Figure 1). After treatment proposal, the patient refused denture replacement due to the high procedural cost. In addition, the prosthesis had a good aspect with satisfactory marginal adaptation around the abutments and good periodontal health. Thus, ceramic repair with composite resin was selected as the treatment of choice.

The ceramic color (A2 shade) was selected using the Vita Classical shade guide (VITA Zahnfabrik, Bad Säckingen, Germany). For control of the oral cavity humidity and patient protection, an alternative field isolation was obtained with the aid of a rubber dam (Madeitex Ltda, São José dos Campos, SP, Brazil), cottons, gauzes and a lip expander (Lip Expand; Indusbello, Londrina, PR, Brazil) (Figure 2). Acid etching was performed with the application of 10% hydrofluoric acid (Porcelain conditioner; Dentsply Ind e Com. Ltda, Petrópolis, RJ, Brazil) for 2 min on the feldspathic ceramic surface (Figure 3). The gel excess was removed with moist gauze to avoid spreading of the product into the patient's mouth, followed by water rinsing for 30 s and drying with an air stream and absorbent paper. Special care was carried out at this step to avoid accidental exposure of soft tissues to the hydrofluoric acid due to the inherent risks of this product.

One-bottle silane coupling agent (Silano, Angelus, Londrina, PR, Brazil) was applied over the etched region for 1 min (Figure 4) followed by the application of the Scotchbond Multipurpose adhesive phase only (3M/ESPE, St. Paul, MN, USA) in the silanized area (Figure 5). The adhesive layer was light cured with a LED curing unit (Radii-E; SDI, Victoria, Australia). A microhybrid composite resin (4 Seasons; Ivoclar Vivadent, Liechtenstein, Germany) was inserted incrementally with a thin A2 dentin layer, followed by A2 enamel and translucent resin layer to repair the fractured angle (Figure 6).

After light curing the composite resin, finishing was performed with abrasive silicone polishing tips (Optimize, TDV Dental, Pomedore, SC, Brazil) (Figure 7). After removing the rubber dam isolation, an occlusal evaluation

was performed to check for any contacts in maximum habitual intercuspation of the anterior teeth and during protrusion movement. The anterior contacts during anterior guidance were distributed to avoid overloading the restored tooth. The occlusal interferences during excursive movements were removed to allow for free mandibular movement<sup>16</sup>. After 24 h, polishing and burnishing were done with silicon tips and felt discs (Felt wheels, TDV Dental) and polishing paste (7026; KG Sorensen, Barueri, SP, Brazil) to create a natural appearance of the repaired ceramic (Figure 8).

### Case 2 - Ceramic Repair with Ceramic Fragment

A 55-year old female patient with a 14-unit metal-ceramic fixed partial denture presented with a dislodgement of the ceramic portion from the metallic structure in the maxillary right canine, probably due to the fatigue of the ceramic structure overloaded during the excursive movements (Figure 9). The patient kept the ceramic fragment. As previously described in Case 1, the replacement of an extensive fixed prosthesis is an expensive treatment, mainly in cases of single-element fracture, and so ceramic repair with composite resin is a viable solution.

The shade of the microhybrid composite selected in this case was B2 dentin (4Season; Ivoclar Vivadent). A rubber dam (Madeitex Ltda) was placed between the abutments to protect the patient and to prevent the contamination of the surface with saliva. Acid etching (Porcelain conditioner; Dentsply) was performed on the ceramic fragment and on the prosthesis structure in the patient's mouth for 2 min (Figure 10). Conditioner excess was removed with moist gauze and the region was rinsed with a water spray for 30 s followed by air drying. Thereafter, the rubber dam was removed due to the difficulty in obtaining a correct positioning of the ceramic fragment, and the area was protected with gauze and cottons rolls.

The union was promoted with a silane agent (Silano, Ângelus), applied in the fragment and in the prosthesis for 1 min followed by the application of the Scotchbond Multipurpose adhesive phase (3M/ESPE) on the silanized area. The activation was carried by a LED curing unit (Radii-E; SDI). The composite resin was inserted in the two ceramic separated parts (Figure 11). The fragment was taken into position and pressed against the prosthesis. Composite excess was removed and light activation was performed (Figure 12).

Subsequently, the excursive movements were checked, reproducing the anterior and canine guidances to achieve a harmonic distribution of the occlusal contacts, eliminating overload of the restored denture and providing free mandibular movements without damaging contacts<sup>17</sup>. Prosthesis repair was finished, reestablishing esthetics and function to the patient (Figure 13).



**FIGURE 1-** Initial aspect of the case with a fracture in the distal angle of the maxillary left central incisor. No ceramic fragment was available



**FIGURE 5-** Application of the adhesive system



**FIGURE 2-** Isolation and protection of the patient's mouth with rubber dam, cottons, gauzes and a lip expander.



**FIGURE 6-** Composite resin insertion over the fractured angle



**FIGURE 3-** Ceramic etching with 10% hydrofluoric acid



**FIGURE 7-** Finishing of the restoration



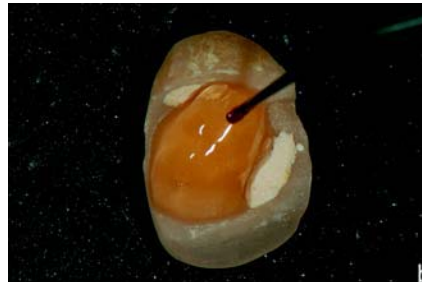
**FIGURE 4-** Application of the silane coupling agent



**FIGURE 8-** Final aspect of the ceramic repair (a and b)



**FIGURE 9-** Initial aspect of the case with a dislodgement of the ceramic portion from the metallic structure in the maxillary right canine (a). View of the ceramic fragment (b)



**FIGURE 10-** Etching of the prosthesis (a) and ceramic fragment (b) with 10% hydrofluoric acid



**FIGURE 11-** Composite resin insertion on the prosthesis (a) and ceramic fragment (b)



**FIGURE 12-** Fragment in position pressed against the prosthesis and composite excess removal



**FIGURE 13-** Final aspect of the ceramic repair

## DISCUSSION

Ceramic fractures may result from trauma<sup>4</sup>, inadequate occlusal adjustment<sup>4,12</sup>, parafunctional habits<sup>12</sup>, flexural fatigue of the metal substructure<sup>12,13</sup>, incompatibility of the coefficient of thermal expansion between the ceramic and the metal structure<sup>5</sup>, failures in the adhesive bonding<sup>12</sup>, inadequate tooth reduction during dental preparation<sup>4,13</sup>, porosities in the ceramic<sup>12,13</sup>, and inappropriate coping design<sup>4,12,13</sup>.

The purpose of any restorative technique is to facilitate the re-adaptation to a healthy condition that is momentarily damaged<sup>18</sup>. In situations of fractured ceramic prosthesis, the possibility of ceramic repair with composite resins is an applicable approach that can restore esthetics and function to the patient in an inexpensive and rapid way.

Metal-ceramic restorations have the potential to fracture. Ceramic failures have been reported as the second greatest cause for the replacement of restorations after dental caries<sup>10</sup>. Furthermore, failures occur most frequently in regions that are quite visible, compromising esthetics<sup>13</sup>. The goal of this clinical report was to demonstrate the potential of repairing ceramics with composite resin. Clearly, the long-term results depend on

the correct execution of the techniques and perfect occlusal adjustment.

Adequate bond between ceramics and composite resins is achieved with a silane coupling agent and an adhesive. Silanes work as mediators promoting adhesion between inorganic and organic matrices through dual reactivity<sup>11</sup>. The treatment with a silane agent contributes to covalent bond formation between the ceramic surface and the composite, and it also improves wetting of the ceramic surface for the composite<sup>3</sup>. Some studies have shown no differences between the use of one-bottle and two-bottle silane couplers, since an increase in the bond-strength of ceramics and composites was observed in both systems after a period of water storage<sup>3</sup>. In addition, a bonding agent is usually applied with the expectation of penetration of monomers into roughened composite surfaces as well as, production of a surface unpolymerized layer after a short of period of light exposure<sup>8</sup>. The use of simplified one-bottle adhesives is not justified because the primer is not needed here, only the adhesive phase of a conventional 3-step system. A 2-step adhesive is not the best choice because as the viscosity is greater, the penetration into the abraded surface presents more difficulty<sup>8</sup>. In addition, a conventional adhesive system produces a best bonding when

ceramics are repaired with composites<sup>6</sup>. Therefore, in order to obtain a satisfactory bond between the ceramic and the composite, conditioning must be performed in the etchable ceramics followed by application of a silane coupling agent in a way to increase the surface energy allowing for a reliable adhesion. It must be kept in mind that surface wetting is an important prerequisite for adhesive bonding<sup>11</sup> and, furthermore, the application of an adhesive layer to the treated area is essential to fill the microporosities before the insertion of a viscous material like a composite resin. On the other hand, in cementation processes of all ceramic restorations with resin cements, the application of adhesives in the ceramic is not necessary due to the better wetting of surface obtained with these flowable materials<sup>19</sup>.

Furthermore, the use of resin cements as way to bond large ceramics fragments as seen in *Case 2* is not indicated because a great amount of ceramic structure was lost with mismatch between the fragment and the prosthesis. The cementation with resin cement in this case would impair the adaptation of the fragment in the correct position. In this way, composites resins are preferred in these situations as they present greater viscosity, facilitating the ceramic repair.

According to Anusavice<sup>1</sup>, innumerable fracture paths of the veneering ceramic can occur. Repairs made on multiple substrates may behave differently than those made only on a ceramic surface. In both cases presented in this article, cohesive and cohesive/adhesive fractures of ceramic were observed and satisfactory results were reached after surface conditioning and silane coupler application followed by repair with composite resin. However, when fractures of metal-ceramic prosthesis occur with metal exposure, minute resin tags are left on the metal surfaces and because of these tags, the fractures are categorized as adhesive failures making the repair more difficult. In these cases sandblasting with 30- $\mu$ m silica coated aluminum-oxide particles (CoJet Sand, 3M-ESPE, Seefeld, Germany) have shown satisfactory results<sup>7,15</sup>. Another possible alternative for these situations is the use of Clearfil SE Bond (Kuraray Co Ltd, Tokyo, Japan) which only requires surface sandblasting and correct product application. However, both materials are costly<sup>15</sup>, which can make their use unviable in some clinical situations.

Repair of ceramic fractures with composite resin results in a reduced clinical time and less treatment sessions for the patient. Moreover, this procedure restores esthetic and function in an easy, inexpensive and rapid form. The treatment option described herein is not intended to be preferred instead of a more definitive treatment for cases of fractured ceramic, that is, denture replacement; the idea is to present a cost-effective alternative for patients who cannot afford a new metal-ceramic prosthesis.

## CONCLUSION

Dental practitioners should be familiar with proper treatments for ceramic fractures. The repair performed with composite resin is an esthetic and functional alternative when extensive fixed partial dentures cannot be replaced.

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