# PORCELAIN FRACTURE REPAIRS USING NEW CHEMICALLY ACTIVE BONDING RESINS

## A discussion of 4-META containing resin and two case reports illustrating its use in the repair of porcelain fractures

Porcelain fractures provide clinical situations which, at times may be difficult to handle. If a crown is otherwise acceptable, a repair of the facing may be attempted, thus avoiding the need for replacement of the prosthesis. Fracture of a porcelain-fused-to-metal restoration can present itself clinically as:

1. Fracture within the porcelain (cohesive failure).
2. Fracture exposing metal and porcelain (cohesive and adhesive failures).
3. Fracture leaving exposed metal substructure only (adhesive failure).

These fractures expose different components of the crown and as such each component (porcelain and metal) must be handled differently.

Preparation of the fractured porcelain surface is achieved by etching with a 9.5 percent hydrofluoric acid (Ceram-Etch, Gresco Products Inc., Stafford, Texas) for a period of five minutes. Should a practitioner prefer not to use hydrofluoric acid, a solution of 1.23 percent acidulated phosphate fluoride may be used for 10 minutes to etch the porcelain surface. These techniques have been shown to be equally effective.[1] Once this is done, a silane coupler is applied to the etched surface and in combination with the etched surface, will allow for bonding of resin to porcelain.[2]

The exposed metal surface requires preparation quite different from that of porcelain. Preparation of the metal can be classified as either macromechanical or micromechanical in nature. Macromechanical retention can be achieved using a rough diamond bur to create scratches in the metal surface. A cross-cut fissure bur can also be used to prepare cross striations in the metal surface. This type of retention can be produced in all types of metal alloys. Micromechanical retention can be produced by air abrading the metal surface with 50 micron grit aluminum oxide. This technique is useful for all alloys and produces a retentive surface that is clean and ready for bonding. The intra-oral production of electrolytically etched surface has also been described and would be useful in retaining resin (etching can be achieved on non-noble alloys).[3]

Several new resins have been developed recently that are able to bond directly to non-noble metal alloys. For example, Panavia EX has recently been introduced and contains a phosphate monomer that achieves a strong bond to tooth structure and to non-noble dental alloys.[4] Panavia was developed as a cement for resin-bonded bridges that were not etched and may serve a useful purpose in attaching veneers to metal substructures. Research in this area is currently underway.[5]

4-META containing resins have been shown to bond to non-noble alloys[6] and are quite useful for porcelain repairs. The material is available in several different formulations (see table, p.22). 4-META is an abbreviation for 4-Methacryloxethyl trimelletate anhydride and bonds to the surface of the metal via the oxide.

This article will illustrate the use of a 4-META containing material in the repair of porcelain fractures of porcelain-fused-to-metal restorations.

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## Case 1

A 35-year-old male presented with a fractured porcelain facing on tooth 11 (Fig 1). The fracture exposed the entire metal substructure and exposed tooth structure at the margin as a porcelain butt margin was involved. Because of time and financial restrictions, replacement of the restoration was not possible and a repair of the fracture was attempted.

1. Fractured porcelain facing exposing metal and tooth structure

2. Composite resin opaque applied to the 4-META surface. Note that the 4-META completely covers the metal surface as well as the exposed tooth structure

3. Repaired porcelain facing

The area was isolated with cotton rolls and cleaned thoroughly with non-fluoridated pumice. The exposed metal surface was further cleaned with 35 percent phosphoric acid for 60 seconds and followed by copious irrigation. Any exposed tooth structure was also etched by this procedure and a bonding resin (Scotchbond II, 3M Dental Products, St. Paul, Minnesota) was applied and cured for 20 seconds.

Super Bond C&B monomer was mixed with a ratio of 4:1::monomer:catalyst, and brushed onto the metal surface. Using the activated liquid, 4-META opaque powder was picked up on a brush and applied to the metal surface as well as to the exposed tooth margin. This was allowed to set for a period of eight minutes until the 4-META set and was hard. Composite resin opaque liquid (Durafill Color VS, Kulzer Inc., Irvine, California) was then applied onto the 4-META surface (Fig.2). and cured for a period of 40 seconds. This was then followed by an incremental application of a veneering composite resin (Durafill VS, Kulzer Inc., Irvine, California)

**Table: 4-META-Containing Adhesive Resins**

Super Bond C&B - Sun Medical Co., Ltd., Kyoto, Japan
Cover Up I and II - Parkell Inc., Farmingdale, New York
Metadent - Preat Corporation, San Mateo, California
Quasar - Rocky Mountain Orthodontic Co., Denver, Colorado
Acrylic Solder - Parkell Inc., Farmingdale, New York

until the facing was built and cured. Polishing and occlusal adjustment followed in the conventional manner (Fig 3).

This repair has now been in place for 12 months and appears to be doing well.

## Case 2

A 40-year-old female patient presentedwith a fractured porcelain-fused-to-metal restoration. The fracture included the distoincisal corner of tooth 21 and exposed porcelain as well as the metal substructure. Several attempts had been made to repair this fracture using a silane coupler to attach composite resin to the exposed porcelain but success was short-lived, lasting no more than one month.

The crown was isolated using a rubber dam, and 9.5 percent hydrofluoric acid was placed on the exposed metal and porcelain. This was left in place for five minutes and then rinsed for one minute (Fig 4). A silane coupler was applied to the etched

4. The exposed porcelain and metal at the fracture site is covered with hydrofluoric acid in order to etch the porcelain

5. 4-META applied to the metal of the fracture site (ivory powder)

6. Completed porcelain repair

porcelain surface (Scotchprime, 3M Dental Products, St. Paul, Minnesota). Super Bond C&B was then mixed and applied as previously described using the ivory powder, because it was felt that the opaque powder would be too opaque (Fig 5). Composite resin opaque liquid was then followed by a composite resin veneer application (Fig 6).

This restoration has been in place for eight months.

**Discussion**

These repairs have been holding up well for both patients. In case 1, the large bonding surface area coupled with the chemical bond of the 4-META material helped in attaching the composite resin veneer to the metal. In case 2, the exposure of several different layers of the restoration made repair slightly more complicated necessitating several additional steps. Nevertheless, the repair was well retained and is functioning.

In both cases air abrading with 50-micron grit aluminum oxide would have assisted in cleansing the metal surface as well as roughening it microscopically to allow for increased retention. Unfortunately, this treatment was not available at the time of repair.

The adhesive resin bonds well to non-noble alloys and preliminary research indicates that it may be useful in adhesion to other alloys including amalgam.[7] The material may be used in a number of different situations.

**Summary**

This paper illustrated the use of a 4-META containing resin in the repair of porcelain fractures. The material lends itself well to this purpose and success was achieved in repairing porcelain fractures on porcelain-fused-to-metal restorations.

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