

A Research Report on Captek™

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Dental materials must fulfill a number of requirements. Ideally, a restoration should identically match the surrounding dentition. Esthetics is often the prime concern of the patient and the dentist. However, other criteria must also be considered when selecting a material for a given clinical situation. We must ensure that our restorations are strong enough to withstand the rigors of the oral environment. The fit is equally important because the time, effort, and expense of the restoration can be negated by leaky margins and resultant secondary decay. In addition to these three criteria, the material must be biocompatible. Finally, practical considerations of ease of fabrication and material cost factor into the choice of restorative materials.

Captek™ is a relatively new restorative system. We felt it was important to evaluate some of the basic properties of this system to examine its capabilities with respect to conventional materials. Therefore, a Doctor of Science research project was performed at Boston University by Dr. Niwut Juntavee, under the direction of Dr. Dan Nathanson and Dr. Russell Giordano. The Captek™ system was evaluated with respect to fit, load bearing capacity, and porcelain adherence. Conventional metal-ceramic alloys were used for comparison. This research resulted in the submission of one paper for presentation at the American Association of Dental Research in March 1995 and two papers for presentation at the International Association of Dental Research in June 1995.

This project can be divided into three main sections: Analysis of Porcelain Shear Bond Strength, Evaluation of Marginal Fit, and determination of Load Bearing Capacity. A brief description of Dr. Juntavee's research follows.

PORCELAIN SHEAR BOND STRENGTH TO A NEW CERAMO-METAL SYSTEM

The Captek™ system is based upon the formation of an interpenetrating Au and Au/Pt/Pd network. The technique consists of

sintering Au/Pt/Pd onto a refractory die to form a porous network, which is then infused with molten Au. This study compares shear bond strength of conventional porcelain applied to several ceramic alloys.

GROUP 1: CAPTEK WITH A THIN LAYER OF BONDING AGENT

GROUP 2: CAPTEK WITH A THICK LAYER OF BONDING AGENT

GROUP 3: YELLOW CERAMIC ALLOY

GROUP 4: WHITE CERAMIC ALLOY

GROUP 5: PALLADIUM BASED CERAMIC ALLOY

GROUP 6: BASE-METAL ALLOY

Ten metal discs of each group, 10 mm in diameter were prepared according to manufacturer's recommendations. Porcelain was applied to the disk surface and was processed as recommended. Shear strength values obtained are:

GROUP 1: 56.08±9.47Mpa

GROUP 2: 27.28±3.32Mpa

GROUP 3: 54.46±9.02MPA

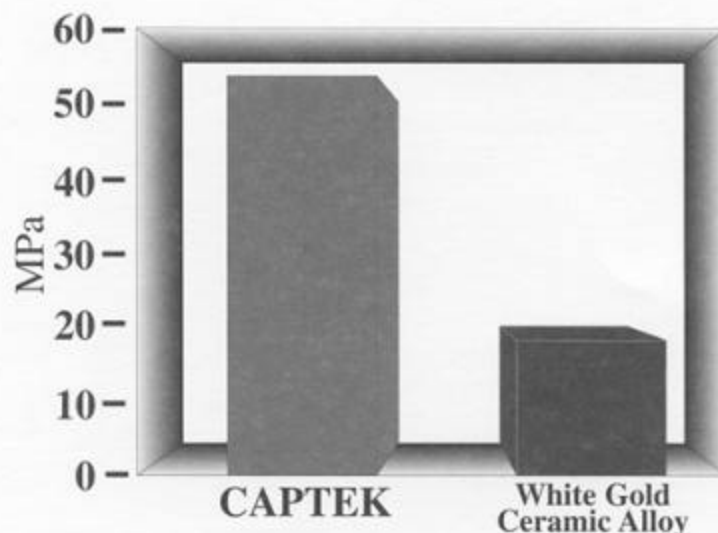
GROUP 4: 21.92±7.26Mpa

GROUP 5: 30.49±11.18Mpa

GROUP 6: 29.93±10.82Mpa

A statistically significant difference between the experimental groups was found. The analysis suggests that ceramic shear bond strength to Captek™ is at least equal to that of conventional ceramo-metals. The use of a thin layer of bonding agent did not affect shear bond strength. However, a thick layer resulted in significant reduction of the shear bond strength.

Porcelain Shear Bond Strength



MARGINAL FIT OF CAPTEK CROWNS AND BRIDGES

This study compares the marginal fit of Captek™ crowns and three bridges with conventional metal-ceramic restorations. A maxillary central incisor crown preparation was produced on an Ivorine tooth with a chamfer margin. A master model abutment and pontic space was fabricated. Identical porcelain fused to metal crowns and bridges were fabricated according to the manufacturers instruction and divided into two groups:

GROUP A: CONVENTIONAL PORCELAIN FUSED TO HIGH NOBLE METAL-CERAMIC ALLOY

GROUP B: CAPTEK™ WITH PORCELAIN BONDING AGENT

The crown and bridge contours were standardized using a jig. Marginal opening was measured at fourteen locations on both bridge abutments and at eight locations on the crowns at 100x using a traveling microscope. The Captek™ restorations have an excellent fit (about 14.5-17.5 microns) and a significantly smaller marginal opening than the conventional metal-ceramic restorations.

LOAD BEARING CAPACITY OF CAPTEK™ CROWNS AND BRIDGES

This study compares the maximum compressive load that a Captek™ crown and a three-unit bridge with a Captek™ porcelain-bonding agent can sustain in comparison to corresponding conventional metal-ceramic crowns and bridges. A maxillary central incisor crown preparation was produced on an Ivorine tooth crown for crown fabrication as well as a master model for the three-unit bridge with a premolar and molar abutment. Identical Captek™ and conventional metal-ceramic restorations were fabricated according to the manufacturers instructions using a jig. Two groups were fabricated:

GROUP A: CONVENTIONAL PORCELAIN FUSED TO A HIGH NOBLE METALLIC-CERAMIC ALLOY

GROUP B: CAPTEK™ WITH BONDING AGENT

All restorations were cemented to acrylic supporting models with zinc phosphate cement and positioned in an Instron. Load bearing capacity of Captek™ crowns is approximately 75 kg. The value for bridges is approximately 210 kg, which is equivalent to the tested conventional metal-ceramics.

DISCUSSION

The high porcelain shear bond strength is probably due to micro-mechanical interlock between the porcelain and the Captek™ surface. This test applied maximum load at the porcelain firing shrinkage.

Marginal accuracy may be due to the elimination of errors inherent in the lost wax technique. Fabrication of a cast substructure involves numerous steps, each of which can contribute to poor fit: wax pattern distortion, improper investment, casting shrinkage.

Load bearing capacity is equivalent to the conventional alloy tested in this project. The micro-substructure (interpenetrating network) as well as the macro-structural design of the Captek™ Bridge may be responsible for this strength. The appearance of the restoration also appears to be enhanced by the gold color of the substructure.