

EFFECT OF DIFFERENT CERAMIC SURFACE TREATMENTS ON ONE-STEP MICRO INDENTATION BOND STRENGTH

S. Doucet*, B. Picard, B. Tavernier.

Laboratoire de biomateriaux. UFR Odontologie Paris7. 5 rue Garancière 75006 Paris, France.

INTRODUCTION: The longevity of the adhesive bond is mostly important for the dentists who carry out all-ceramic restorations. First, the adhesive material must be tested in vitro. There are no ideal adhesion tests. Traditional tests for strength measurement have shown large deviations, and results from the different tests cannot be correlated with one another. The shear test and tensile bond test are usually chosen. The average stress value shows little relationship to the failure stress because of uneven distribution at the interface [1]. The normal indentation Vickers test appears good to test the bond strength on brittle materials such as ceramics. The purpose of this study was to evaluate the effect of different ceramic surface treatments on debonding by indentation.

METHODS: One-step® (Bisco) was applied on feldspar sample vitablocs® (Vita) and penetrated by a normal Vickers indenter (Leitz durimet 2, Wetzlar). Four groups (Gp) of four samples were tested. Each group had had a different surface treatment (table1). The bonding agent was applied to a thickness of 6µm. Ten Vickers indentations (20N, 30s) were made on each sample. The stress field generated observable halos in light microscopy. Adhesive bonding strengths were calculated for thin films on a rigid substrate [2] using the formula:

$$\sigma = \frac{EH\theta}{a(1 - \nu^2)} \frac{1.886x^2[(1 - x^2) + (1 + x^2)] \ln x}{(2x \ln x)^2 - (1 - x^2)^2}$$

σ: bond strength, x = a/b, a: radius of indenter
b: radius of halo, E: modulus of elasticity of film 1.9 Gpa. H: thickness of film. ν: 0.3. Poisson's ratio.
θ: assumed slope at inner edge of debonded film.

Table 1: Surface treatments and results.

group	surface treatments	σ MN/m ²	SD
Gp 1	polished 4000	12 ^a	10
Gp 2	polished 4000 + silane	25 ^b	28
Gp 3	polished 4000 sanded, etched	48 ^c	48
Gp 4	polished 4000 sanded, etched + silane	53 ^c	40

Means with different letter are significantly different at p < .05.

Silane: Silicoup® Kulzer two coats. Etching agent: Vita ceramics etch® hydrofluoric acid 3mn.

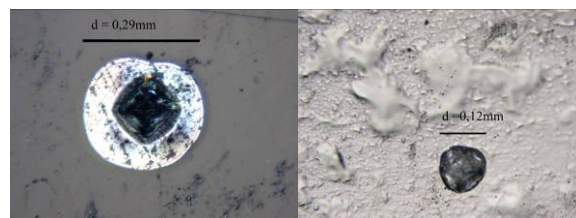
RESULTS: A one way Anova and Student-test were used. Group1 showed the significantly lowest result for bonding strength (p < .05). The bond strength was significantly affected by the surface treatment (The results are presented in table 1).

DISCUSSION & CONCLUSIONS: The Vickers indentation test revealed the varied behavior of the bond. The results agree with conclusions of other authors who have tested adhesive agent on ceramics: sand and acid attacks create microporosity and permit interlocking which favours the adhesion mechanisms (gp3 > gp1). The silane treatment was an important factor responsible for resin bonding to ceramics (gp4 > gp1; gp2 > gp1) [3]. Silanisation of ceramics was considered controversial when it was used simultaneously with acid etching. Group 4 showed an average bonding strength which was higher than that of group 3, but this result was not significant (p > .05). The standard deviation was large in all groups: measurements were very dependent the individual defects which were included in the measurement. The results of the shear bond and tensile bond tests depended strongly on the defects in the interface. So, it was particularly important to measure bond strengths on small areas [4]. In fact, small surface areas were associated with high bond strength because there were fewer defects in a small area.

This test permitted local evaluation of adhesive debonding over small surface areas. The results of this study demonstrate the possibility of a new approach to bond strength by indentation. Surface treatment is essential to obtain best bond strength.

Fig1: Halo from group1

Halo from group 4



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4. H Sano (1994) Dent mater 1994 July 10: 236-40.