

Effect of Air-abrasion on Micro Shear Bond Strength of Two Resin Cements to Cercon Porcelain

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Abstract: In preparation of All-Ceram restorations with Zirconia Bases choosing appropriate cement with maximum strength and a proper method for decontamination of restoration surface in case of contamination to saliva is of great importance for the prognosis of the restoration. According to previous studies, Panavia F2 is the preferred cement for restoration of All-Ceram Zirconia based cements. Regarding the limited number of studies related to comparison of bond strength new cements with Panavia F2 and absence of data in respect to the effect of Air-abrasion on the bond strength, the aim of this study was to evaluate the bond strength of Panavia F2 and Rely XU₁₀₀ to Cercon porcelain with and without Air-abrasion. About 12 porcelain blocks of 17.5×7×1.5 mm³ were prepared using CAD/CAM method. Specimens were divided into 2 groups of 6 blocks each (Air-abraded and non-Air-abraded) then 36 cylinders (0.6 mm² ×1 mm) of each resin cements were prepared according to the manufactures instructions. In each group, 18 specimens were bonded to the three Air-abraded and three non-air-abraded porcelain blocks. Cercon blocks bonded to resin cylinders were placed in the Micro shear bond strength tester and the data were recorded. The results were then analyzed with two-way Anova analysis using SPSS (version 11.5). The mean value of micro shear bond strength for Panavia F2 group bonded to Air-abraded and non Air-abraded Cercon blocks were 72.2 N (120 Mp) and 48.44 N (48 Mp) for Panavia F2 and 46.22 N (77.03 Mp) and 40.16 N (66.93 Mpa) for Rely XU₁₀₀, respectively. Micro shear bond strength values for Panavia F2 cement were significantly higher than those for Rely XU₁₀₀. Air abrasion has increased micro shear bond strength in both groups and the amount of increase was significant in Panavia F2 group (p<0.001). Air-abrasion before cementation increases bond strength to Cercon porcelain.

Key words: Micro shear bond strength, Air-abrasion, resin cement, cercon porcelain, zirconia, cementation

INTRODUCTION

Zirconia-based porcelains use has been increased for preparation of All-Ceram restorations. In cementation of these restorations, choosing the proper cement with maximum strength is of great concerns for the clinicians. On the other hand, contamination of restoration with saliva is probable and can affect the prognosis of restoration. Zirconia based ceramics were introduced 15 years ago following the low strength of Alumina-based porcelains (Blue *et al.*, 2003).

These restorations became more current due to their higher strength compared to Alumina-based porcelains (Kem and Wegner, 1998; Quass *et al.*, 2007; Wolfart *et al.*, 2007). For cementation of Zirconia-based ceramic restorations, resin cements which contain phosphate monomers like Panavia F2 are needed (Wolfart *et al.*, 2007; Wegner and Kern, 2000).

Some of the advantages of Panavia F2 are higher retention, lower solubility, lower compressive strength

and elastic modulus but the disadvantages of these cements are technique sensitivity and their difficult use (Wegner and Kern, 2000; Tinschert *et al.*, 2001; Silverstone *et al.*, 2006). During the recent years, several resin cements such as Rely XU₁₀₀ and RelyXUnicem have been introduced which seems to trim down the weak points of Panavia F2 however, the effectiveness of these cements and their bond strength to Zirconia-based ceramics has not been evaluated accurately yet. Due to the probable contamination of these restorations with saliva, several methods have been used for surface treatment of these restorations i.e. Air-abrasion using silane and silica coating of restorations which can increase porcelain bond to resin cements (Wolfart *et al.*, 2007; Blatz *et al.*, 2003a, b; Kern and Thompson, 1994), however related studies are limited. Regarding the fracture point of All-Ceram restorations which mostly occur in the cement-ceramic junction, researches have been concentrated on this matter. Etching of internal surface of Alumina-based or Zirconia-based porcelains with

Hydrofluoric acid dose not lead to an increase in bond strength of resin cements like silicon-based porcelains. Quass *et al.* (2007) have been evaluated the effect of different surface treatments on bond strength of Panavia F2 to Cercon porcelain. In their study they have contaminated 80 specimens of discoid Cercon with saliva and divided the specimens into 5 groups and treated them using 4 different methods, Air-abrasion with 50 μ Al₂O₃ for 15 sec, 37% phosphoric acid for 60 sec, 37% phosphoric acid for two intervals of 30 sec and 96% isopropanol. Then specimens were bonded to composite cylinders and their tensional strength was assessed. The results showed that Air-abrasion increased the bond strength of Panavia F2 to Cercon porcelain. Szep *et al.* (2003) have evaluated the effect of several decontamination methods of ceramic surfaces contaminated with silicon disclosing agents on bond strength of RelyXUnicem to Procera, the used methods were 9.5% hydrofluoric acid for 60 sec, 37% phosphoric acid for 30 sec, Air-abrasion with 50 μ Aluminum, Air-abrasion with 110 μ Al₂O₃. In this study 120 discoid specimens of Procera contaminated with silicon disclosing agents were used with the aforementioned methods.

In the second step, Composite cylinders of Clearfill F2 were bonded to the ceramic surface and their Shear bond strength was recorded. Favorable results were shown in the Air-abrasion group but there were no significant differences between 50 μ and 110 μ Al₂O₃. Wegner and Kern (2000) has conducted a study to evaluate the long-term bond strength of different resin cements to Lava Zirconia-based porcelains. For this purpose, 86 composite cylinders were bonded to ceramic blocks using three resin cements, Panavia F2, RelyXUnicem and Rely XARC and their shear bond strength were determined after thermo cycling. RelyXUnicem and Panavia F2 showed higher strength compared to RelyXARC but not significantly different; they also showed that after 150 days, Panavia F2 showed significantly more bond strength.

Borges *et al.* (2007) assessed the bond strength of resin cements to Alumina-based porcelains. They have prepared 120 cylindrical specimens of RelyXUnicem and Panavia F2 resin cement and bonded them directly to In-ceram ceramic specimens and evaluated the microshear bond strength of the specimens.

The results of this study showed that microshear bond strength of Panavia F2 cement to In-Ceram porcelain is significantly higher than RelyXUnicem. It is obvious that the number of studies which evaluate the effect of Air-abrasion on micro shear bond strength of resin cements (Rely XU₁₀₀ and Panavia F2) to Cercon Zirconia-based porcelains are limited. So this study have been designed to assess bond strength of Cercon Zirconia-based porcelain with two resin cements (Rely XU₁₀₀ and Panavia F2) with and without Air-abrasion surface

treatment which may lead to a quantum leap in the process of selecting a proper resin cement and optimization of bond strength after contamination with saliva.

MATERIALS AND METHODS

About 12 Cercon blocks, 36 resin cylinders of Panavia and 36 resin cylinders or Rely XU₁₀₀ were prepared. For preparation of Cercon blocks with CAD/CAM method, a metal Cr-Co rectangular cube of 17×7×1.5 mm³ was scanned in Cercon eye (Degudent, Detsply, Germany-Hamburg) and the extracted data was processed with Cercon Brain and calculations were done for magnifying the specimens. Finally milling process was done on a prefabricated Cercon base (94% ZrO₂, Stabilized by 5% Y₂O₃, Degudent, Germany Batch No. 2000, 924) then specimens were sintered in Cercon Heat to reach the ideal size and final strength. In this way 12 specimens were prepared. To contaminate the specimens, saliva was collected from operator who were fast for 1.5 h prior to the collection time, then all specimens were placed in saliva for 1 min and irrigated with the usual method in clinic and then cleaned for 15 min using (BIB Forte (Dental-Produkte GMBH, Alpro^R, Frankfurt, Germany Art No. 3024) solution in Ultrasonic cleaner (Quantrex^R 90^{wt}L and R manufacturing Laths, Finland) Specimens then divided into 2 groups of 6.

Group 1: The specimens were treated with 50 μ Al₂O₃ for 15 sec from 10 mm distance (Blatz *et al.*, 2003a, b; Kem and Wegner, 1998; Wegner *et al.*, 2002).

Group 2: The specimens surfaces were not treated. For preparation of resin cylinders, 1 mm Tagon tubes with 0.6 mm diameter were prepared. Resin cements which were used in this study were Panavia F2 (Kurary Medical INC, Osaka, Japan, Lot no 725.1) and Rely XU₁₀₀ (3 mespe, St. Paul, MN USA, Iotno 1012). Cements were mixed according to their instructions and put into Tagon Tubes and bonded to Cercon Porcelain blocks.

In this way, Cercon porcelain blocks were provided which had 16 resin cement cylinders of the aforementioned resin cements with 1 mm height and internal diameter of 0.6. About 18 resin cylinders of Panavia F2 were bonded to 3 Air-abraded Cercon blocks and 18 of them were bonded to 3 non Air-abraded Cercon blocks. For Rely XU₁₀₀, 18 resin cylinders were bonded to 3 Air-abraded Cercon blocks and 18 of them were bonded to non Air-abraded Cercon blocks. Resin cylinders were bonded to ceramic blocks in 2 rows and 3 columns arrangement.

After bonding of resin cylinders to Cercon blocks, all specimens were put in 37°C distilled water for 48 h (Wegner and Kern, 2000; Tinschert *et al.*, 2001) then

specimens were Thermo cycled 500 times in 6-55°C with 10 sec intervals (Guazzato *et al.*, 2005; Nularen and White, 2000). For calculation of Micro shear bond strength of specimens, Micro shear Tester (Micro shear tester, Bisco, Michigan, USA) was used and bond strength of the specimens were recorded. Statistical analysis was done using SPSS (Version 11.5). The correlation between Air-abrasion on Cercon porcelain and the resulted changes in micro shear bond strength of Panavia F2 and Rely XU₁₀₀ resin cements was calculated with 95% of accuracy. In this study, two way Anova analysis was done (p = 0.05).

RESULTS AND DISCUSSION

Mean values and standard deviation of micro shear bond strength of Panavia F2 and Rely XU₁₀₀ in Air-abraded and non Air-abraded groups are shown in Table 1.

Table 2 shows the comparison of bond strength in different groups. The difference between Air-abraded and non Air-abraded groups for Rely XU₁₀₀ is not significant. Also there is no significant difference between the bond strength of Panavia F2 without Air-abrasion and Rely XU₁₀₀ with Air-abrasion.

In the present study, 72 resin cylinders (36 resin cement cylinders of Panavia F2 and 36 resin cylinders of Rely XU₁₀₀) were bonded to 12 ceramic blocks of Cercon Zirconia-based porcelain.

Of these blocks, six were Air-abraded and the other half were not. The results of Micro shear bond strength showed that under the limitations of this study the micro shear bond strength of resin cements to Cercon increases if the specimens are subject to Air-abrasion.

This difference was significant for Panavia F2 but not for Rely XU₁₀₀. Kem and Wegner (1998) and Blatz *et al.* (2003a, b) in a study on Zirconia-based porcelains showed that Air-abrasion can significantly increases shear bond strength of porcelain to resin cements with phosphate monomers content e.g. Panavia F2.

These results are similar to those of the present study however, the assessed bond strength is different. In the reviewed literatures (Quass *et al.*, 2007; Blatz *et al.*, 2003a, b; Silverstone *et al.*, 2006) the common point is evaluating the shear and tensile strengths; however, micro shear bond strength is investigated in this study which has been claimed to be more reliable (Blatz *et al.*, 2003a, b) because:

- In micro shear tests the stress distribution in the bonding surface of specimens is more homogenous due to lower dimensions of specimens (1 mm × 0.6 mm² compared to 8×3.4 mm) therefore, the statistical analysis would be more accurate

Table 1: Mean, standard deviation of micro shear bond strength based on the resin cements and Air-abrasion

Groups*	Mean (Mp)	Number	SD
PF2.0	48.44 (80)	18	8.38
PF2.1	77.22 (120)	18	11.44
U ₁₀₀ .0	40.16 (66.93)	18	5.85
U ₁₀₀ .1	46.22 (77.03)	18	7.46
Total	51.76 (82.26)	72	14.84

*PF2. 0: Panavia F2 bonded to Cercon, non Air-abraded, PF2. 1: Panavia F2 bonded to Cercon, Air-abraded, U₁₀₀. 0: Rely XU₁₀₀ bonded to Cercon, Non Air-abraded and U₁₀₀. 1: Rely XU₁₀₀ bonded to Cercon, Air-abraded

Table 2: Comparison between groups (interactions)

Comparison between two groups*	p-value	Result
PF2.0/PF2.1	<0.001	Significant
PF2.0/U ₁₀₀ .0	0.025	Significant
PF2.0/U ₁₀₀ .1	0.863	Non-Significant
PF2.1/U ₁₀₀ .0	<0.001	Significant
PF2.1/U ₁₀₀ .1	>0.001	Significant
U ₁₀₀ .0/U ₁₀₀ .1	0.154	Non-Significant

*PF2. 0: Panavia F2 bonded to Cercon, Non Air-abraded, PF2. 1: Panavia F2 bonded to Cercon, Air-abraded, U₁₀₀.0: Rely XU₁₀₀ bonded to Cercon, Non Air-abraded and U₁₀₀.1: Rely XU₁₀₀ bonded to Cercon, Air-abraded

- Because of lower size of contact surface between cylindrical specimens and discoid or rectangular ones, stress concentration is decreases so that the failure pattern shifts to adhesive instead of cohesive failure and this will decreases the errors
- Due to lower size of specimens, resin cements can directly be bonded to rectangular or discoid specimen and there is no need for composite cylinders

Matinlinna *et al.* (2006) evaluated Panavia F2 to Procera porcelain bond strength and their results showed that using resin cements can increase bond strength to Zirconia-based porcelains. This study has also similar results with the study that showed there is a significant difference between bond strength of resin cements which contain phosphate monomer (Panavia F2) and resin cements containing Bis-GMA and HEMA (RelyXU₁₀₀). Wolfart *et al.* (2007) and Quass *et al.* (2007) in their studies on bond durability of resin cements to Zirconia-based porcelains showed that Air-abrasion with 50 μ Al₂O₃ is more successful than other methods.

Derband and Derband (2000) in their study about the effect of surface treatment on auto-polymerized cements did not observe any difference on the bond strength and its durability. The difference between these results with present study may be due to not using the thermo-cycling in these literatures.

Thermo cycling is currently known as one of the required conditions for simulating the aging and biologic condition of the oral cavity and it has a great effect on bond strength of specimens (Wegner and Kern, 2000; Tinschert *et al.*, 2001; Nularen and White, 2000).

Noteworthy that due to limited studies on Rely XU₁₀₀ as a recently introduced cement and no available study which compares this cement with Panavia F2, there are inadequate data which demonstrate the properties of this material.

CONCLUSION

Micro shear bond strength of Panavia F2 to Cercon porcelain is significantly higher than Rely XU₁₀₀. Air-abrasion increases micro shear bond strength of Panavia F2 to Cercon porcelain significantly, Air-abrasion increases micro shear bond strength of Rely XU₁₀₀ to Cercon porcelain but this increase is not statistically significant, Panavia F2 resin cement is recommended for cementation of Cercon restorations and Despite the simplicity and less technique sensitivity of using Rely XU₁₀₀ compared to Panavia F2, lower bond strength has been shown for Rely XU₁₀₀.

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