

# Adhesive cementation protocol of Zirconia restorations

**Language:** English

## Authors:

Dr. Ana Petre,  
Oral Rehabilitation Department, University of Medicine and Pharmacy Carol Davila, Bucharest, Romania  
Dr. Ruxandra Sfeatcu,  
Oral Health Department, University of Medicine and Pharmacy Carol Davila, Bucharest, Romania

## Date/Event/Venue:

April 28th - May 1st 2011  
16th Congress of the Balkan Stomatological Society  
Bucharest, Romania

## Introduction

Continuous evolution of dental materials has determined the development of some new and modern manufacturing and cementing techniques for indirect restorations. Due to the relatively recent entry of zirconia and alumina based ceramics in Romanian Dental Practice, there is a lack of information about adhesive cementation technique or, more accurate, about the special preparation of zirconia and alumina surface in order to use an adhesive cementation.

## Objectives

Our aim is to acquaint practitioners with particular structure of zirconium oxide and microscopic interaction with resin cement in adhesive cementation.

## Material and Methods

In Romanian dental laboratories are currently used some of the many available brands of zirconia such: ZirCAD (Ivoclar Vivadent), Cercon®Zirconia (Dentsply), Zirot (Wieland), Procera Crown Zirconia (Nobel Biocare), Ceramill (Amann Girrbach), Lava (3M), inCoris (Sirona) and inVizion (Vita). We have studied the indications provided by each manufacturer regarding to preparation of the zirconia surface for the adhesive cementation.

## Results

All 8 manufactures (Table 1) indicate to sand blast the inner surface of zirconia restoration with  $Al_2O_3$  particles, 50-110  $\mu m$  sizes, at different pressure (1-2,8 bar). Furthermore they indicate to use a primer or adhesive cement with MPD monomer. The only exception is 3M Espe which provide one product for silicatisation, Rocatec®Plus, silica-coated  $Al_2O_3$  110  $\mu m$  particles, in order to improve the bonding between a non-MDP resin cement like Relyx ARC® and zirconia surface.

Zirconia	Sand blasting	Pressure	Silicatisation	Silanisation	Adhesive Cement self/adhesive
<b>IPS ZirCAD<sup>1</sup></b> Ivoclar	$Al_2O_3$	1 bar	NO	Monobond Plus® Ivoclar	Variolinkv II (Ivoclar) Multilink® (Ivoclar) SpeedCEM® (Ivoclar)
<b>Cercon<sup>2</sup></b> Dentsply	50 50 $\mu m$ $Al_2O_3$	2-3 bar	NO	Prime&Bond NT® (Dentsply)	Calibra Esthetic Resin Cement® (Dentsply)
<b>Zirot</b> Wieland	$Al_2O_3$	1 bar	NO	ED Primer A,B® (Kuraray)	RelyX Unicem® (3M Espe) Panavia® F2.0 (Kuraray)
<b>Procera Zirconia<sup>2</sup></b> Nobel Biocare	max. 100 $\mu m$ $Al_2O_3$	2.5 bar	NO	Alloy Primer® (Kuraray)	Panavia® 21TC (Kuraray) RelyX Unicem® (3M Espe)
<b>Ceramill<sup>4</sup></b> Amann Girrbach	110 $\mu m$ $Al_2O_3$	1 bar	NO	Monobond Plus® (Ivoclar)	Multilink® (Ivoclar)
			YES	Espe Sil® (3M Espe)	RelyX&t; ARC® (3MEspe)*
<b>Lava<sup>5</sup></b>	$Al_2O_3 + SiO_2$	$\geq 2.8$			

3M Espe	bar	NO	NO	RelyX unicem® (3M Espe)
<b>inCoris<sup>6</sup></b> Sirona	50 µm Al <sub>2</sub> O <sub>3</sub>	≤ 2.5 bar	NO	Panavia® F2.0 (Kuraray) Panavia® 21TC (Kuraray)
<b>inVizion<sup>7</sup></b> Vita	max. 50 µm Al <sub>2</sub> O <sub>3</sub>	2.5 bar	NO	Panavia® F2.0 (Kuraray) Panavia® 21TC (Kuraray)

Table 1: Manufacturer's indications for adhesive cementation [\*non MDP Adhesive Cement]

## Conclusions

Zirconia ceramic is a glass-free polycrystalline microstructure, with high fracture strength and fracture toughness, but in the same time an acid-resistant or non-etchable material. This fact determines a lack of adhesion for resin cements. For this reason, there have been some efforts of manufacturers and researchers to modify the surface properties of zirconia by using various methods.

The most used two methods are:

- 1.) The first method, is the usage of a ceramic primer or resin cement, which contains a bio-functional monomer, 10-methacroyloxydecyl-dihydrogenphosphate (MDP) (fig. 1). The acidic phosphate groups of this monomer have the property to combine directly with metal oxides 8 as ZrO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, etc. (fig. 2). In vitro studies have proved that the presence of MDP monomer only in primer provide lower bond strength then the usage of both MDP primer and MDP resin cement 9. In addition, different studies, demonstrate that a combination between MDP monomer and a silane-coupling agent on silica-coated zirconia restoration could be a promising method for improving bond strength of resin cements 10.
- 2.) The second method called "silicatisation", is usually applied in dental laboratories and it is represented by an airborne particle abrasion using 50-110 µm Al<sub>2</sub>O<sub>3</sub> coated with silica (fig. 3). Because of the very high speed of these particles, about 1000km/h11, they are embedded on the Zirconia, resulting the chemically silica-modified surface 12. Furthermore this surface is acting like an usual glass ceramic material and resin cement bonds to it via silane agent (fig. 4).

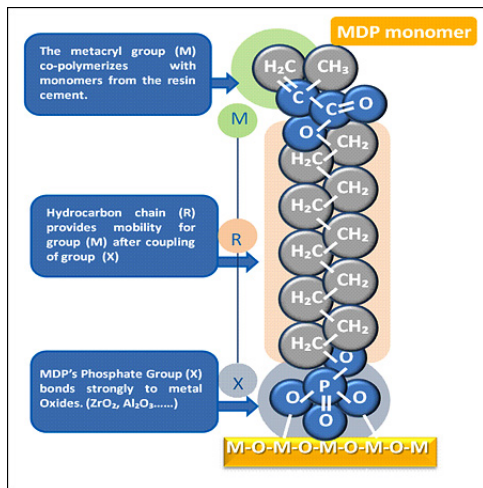


Fig. 1: MDP monomer - chemical structure

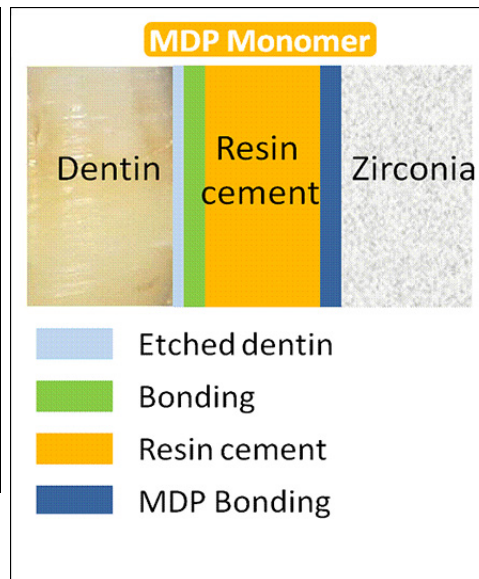


Fig. 2a: Successive layers between dentin and zirconia surface in MDP cementation/silicatisation

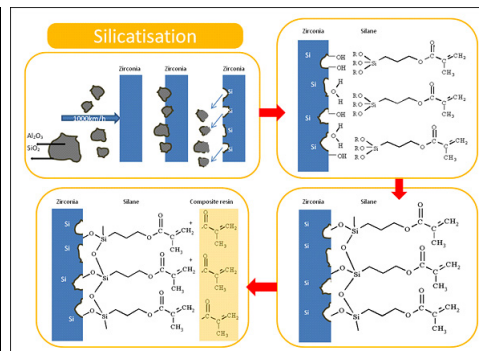
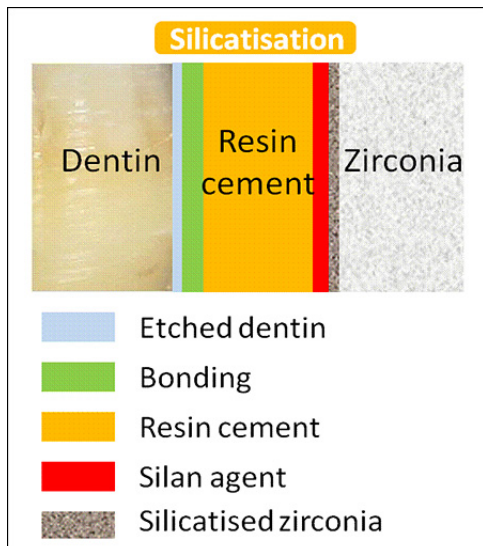


Fig. 2b: Successive layers between dentin and zirconia surface in MDP cementation/silicatisation

Fig. 3: Silicatisation process

## Literature

1. [www.ivoclarvivadent.com](http://www.ivoclarvivadent.com); IPS e.max® System Ivoclar Vivadent Tehnical;43
2. [www.dentasply.com](http://www.dentasply.com); Cercon Zirconia Clinic Recomendations;1
3. Michael Hummel, Matthias Kern; Durability of the resin bond strength to the alumina ceramic Procera; Dental Materials (2004) 20, 498-508
4. [www.wieland-dental.com](http://www.wieland-dental.com); Supplement to the Zirox® Instructions for Use (dated 07/05);5
5. <http://solutions.3m.com>; All-ceramic System; Tehnical product profile Lava;13
6. [www.sirona.com](http://www.sirona.com); Sirona Dental Systems GmbH; Processing instructions inCoris ZI;7
7. [www.vident.com](http://www.vident.com); inVizion Preparation and Cementation;© Vident 2008;
8. Moustafa N. Aboushelib, Mona Ghoniem, Hesam Mirmohammadi, Ziad Salameh, General principles for achieving adequate bond to allceramic Restorations, Journal of Dentistry and Oral Hygiene Vol. 1(3), September, 2009;036-041
9. T. T. Heikkinen, J. P. Matinlinna, P. K. Vallittu, L. V. J. Lassila, Effect of Primers and Resins on the Shear Bond Strength of Resin Composite to Zirconia, SRX Dentistry, Volume 2010,6
10. R. Tanaka, A. Fujishima, Y. Shibata, A. Manabe and T. Miyazaki, Cooperation of Phosphate Monomer and Silica Modification on Zirconia, J DENT RES 2008 87: 666
11. <http://solutions.3m.com>; Rocatec Bonding, Scientific Product Profile;5
12. Mutlu ÖZCAN, Henk NIJHUIS, Luiz Felipe VALANDRO, Effect of Various Surface Conditioning Methods on the Adhesion of Dual-cure Resin Cement with MDP Functional Monomer to Zirconia after Thermal Aging, Dental Materials Journal 27(1) ,2008: 99-104

*This Poster was submitted by Dr. Ana Petre.*

### Correspondence address:

Dr. Ana Petre  
University of Medicine and Pharmacy Carol Davila  
Oral Rehabilitation Department  
31, Anton Pann Str.  
Bucharest  
Romania

# Adhesive cementation protocol of Zirconia restorations

Ana Petre<sup>1</sup>, Ruxandra Sfeatu<sup>2</sup>

<sup>1</sup> Oral Rehabilitation Department, <sup>2</sup> Oral Health Department

University of Medicine and Pharmacy "Carol Davila", Bucharest, Romania

## INTRODUCTION

Continuous evolution of dental materials has determined the development of some new and modern manufacturing and cementing techniques for indirect restorations. Due to the relatively recent entry of zirconia and alumina based ceramics in Romanian Dental Practice, there is a lack of information about adhesive cementation technique or, more accurately, about the special preparation of zirconia and alumina surface in order to use an adhesive cementation. Our aim is to acquaint practitioners with particular structure of zirconium oxide and microscopic interaction with resin cement in adhesive cementation.

## METHOD

In Romanian dental laboratories are currently used some of the many available brands of zirconia such: ZirCAD (Vivadent), Cercon®/Zirconia (Dentsply), Zirax (Weland), Procera Crown Zirconia (Nobel Biocare), Ceramill (Amann Girrbach), Lava (3M), inConis (Sierra) and inVizion (Vita). We have studied the indications provided by each manufacturer regarding to preparation of the zirconia surface for the adhesive cementation.

## RESULTS

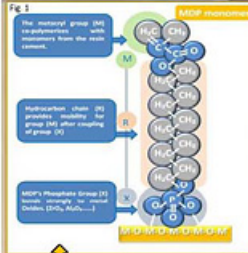
All 8 manufacturers (Table 1) indicate to sand blast the inner surface of zirconia restoration with Al<sub>2</sub>O<sub>3</sub> particles, 50-110 µm sizes, at different pressure (1-2.8 bar). Furthermore they indicate to use a primer or adhesive cement with MDP monomer. The only exception is 3M Espe which provide one product for silicatisation, Rocotec®Plus, silica-coated Al<sub>2</sub>O<sub>3</sub> 110 µm particles, in order to improve the bonding between a non-MDP resin cement like Relyx AROB and zirconia surface.

## DISCUSSION

Zirconia ceramic is a glass-free polycrystalline microstructure, with high fracture strength and fracture toughness, but in the same time an acid resistant or non-etchable material. This fact determines a lack of adhesion for resin cements. For this reason, there have been some efforts of manufacturers and researchers to modify the surface properties of zirconia by using various methods.

Table 1

Zirconia	Sand blasting	Pressure	Silicatisation	Silicatisation	Adhesive Cement
IPS ZirCAD <sup>1</sup>	Al <sub>2</sub> O <sub>3</sub>	3 bar	NO	Monobond Plus <sup>2</sup> Primer	Vanish <sup>3</sup> II Resin Multilink <sup>4</sup> Resin Spontix <sup>5</sup> Resin
Cercon <sup>6</sup> Zirconia	50µm Al <sub>2</sub> O <sub>3</sub>	2-3 bar	NO	Prime&bond NT <sup>7</sup> Dentistry	Calibra Esthetic Resin Coment <sup>8</sup> Dentistry
Zirax <sup>9</sup> Zirconia	Al <sub>2</sub> O <sub>3</sub>	3 bar	NO	EQ Primer A <sup>10</sup> B <sup>11</sup> Primer	Relyx Unicem <sup>12</sup> Resin Panavia <sup>13</sup> F2.0 Resin
Procera Zirconia <sup>14</sup>	max. 100 µm Al <sub>2</sub> O <sub>3</sub>	2,5 bar	NO	Alloy Primer <sup>15</sup> Resin	Panavia <sup>13</sup> 21TC Resin Relyx Unicem <sup>12</sup> Resin
Ceramill <sup>16</sup> Amann Girrbach	110 µm Al <sub>2</sub> O <sub>3</sub>	3 bar	NO	Monobond Plus <sup>2</sup> Primer	Multilink <sup>4</sup> Resin
Lava <sup>17</sup> 3M Espe	Al <sub>2</sub> O <sub>3</sub> +SiO <sub>2</sub>	22,8 bar	YES	Espe Sil <sup>18</sup> Primer	Espe <sup>19</sup> N <sup>20</sup> A <sup>21</sup> Resin <sup>22</sup>
inConis <sup>23</sup> Sierra	50µm Al <sub>2</sub> O <sub>3</sub>	12,5 bar	NO	NO	Panavia <sup>13</sup> F2.0 Resin Panavia <sup>13</sup> 21TC Resin
inVizion <sup>24</sup> Vita	max. 50µm Al <sub>2</sub> O <sub>3</sub>	2,5 bar	NO	NO	Panavia <sup>13</sup> F2.0 Resin Panavia <sup>13</sup> 21TC Resin

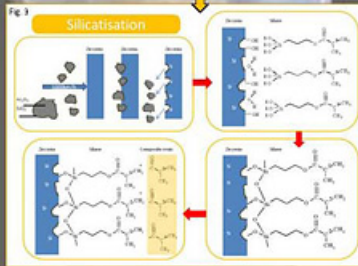


The most used two methods are:

1. The first method, is the usage of a ceramic primer or resin cement, which contains a bio-functional monomer, 10-methacryloyloxydecyl-dihydrogenophosphate (MDP) (fig.1). The acidic phosphate groups of this monomer have the property to combine directly with metal oxides<sup>8</sup> as ZrO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, etc. (fig.2).

In vitro studies have proved that the presence of MDP monomer only in primer provide lower bond strength than the usage of both MDP primer and MDP resin cement<sup>9</sup>. In addition, different studies, demonstrate that a combination between MDP monomer and a silane-coupling agent on silica-coated zirconia restoration could be a promising method for improving bond strength of resin cements<sup>10</sup>.

2. The second method called "silicatisation", is usually applied in dental laboratories and it is represented by an airborne particle abrasion using 50-110 µm Al<sub>2</sub>O<sub>3</sub> coated with silica (fig.3). Because of the very high speed of these particles, about 1000km/h<sup>11</sup>, they are embedded on the Zirconia, resulting the chemically silica-modified surface<sup>12</sup>. Furthermore this surface is acting like an usual glass ceramic material and resin cement bonds to it via silane agent (fig.4).



## CONCLUSIONS

Adhesive cements have different composition and lack of knowledge concerning the properties of these materials and their interaction with zirconia/alumina may compromise long-term outcome.

## REFERENCES

1. www.invisiobond.com; IPS a multi System Resin Vivadent Vivadent-40  
 2. www.dentsply.com; Cercon Zirconia Clinic Recommendations 1  
 3. www.weland.com; Multilink Resin; Quality of the resin bond strength to the alumina ceramic  
 4. www.dentsply.com; Spontix Resin; Supplement to the Clinix Instructions for Use (Issue 07/05/05)  
 5. www.dentsply.com; Alloy Primer System; Technical product profile Lava 3  
 6. www.3m.com; Sierra Dental Systems GmbH; Processing instructions InConis 237  
 7. www.3m.com; Vita InVision Preparation and Cementation 08 March 2005, 1  
 8. Mustafa N, Abuelsabbah, Mosa Shomran, Hecem Memochamrad, Zaid Sabeha; General principles for attaining adequate bond to all-ceramic Restorations; Journal of Dentistry and Oral Hygiene Vol. 1(3), September, 2009:238-241  
 9. T.T. Haddad, J. P. Madhoun, P. E. Gattas, L. V. J. Landa; Effect of Primer and Resin on the Shear Bond Strength of Resin Composites to Zirconia; SVE Dentistry, March 2010:8  
 10. R. Senzaki, A. Fujimoto, T. Shibata, A. Mizuta and T. Miyazaki; Cooperation of Phosphate Monomer and Silica Modification on Zirconia; J DENT RES 2008 87: 656  
 11. www.3m.com; Sierra Dental Systems GmbH; Processing instructions InConis 237  
 12. Maki, OZCAR, Heik NIKKILIN, Lutz Felge, WILKINGO; Effect of Various Surface Conditioning Methods on the Adhesion of Dual-Cure Resin Cement with MDP Functional Monomer to Zirconia after Thermal Aging; Dental Materials Journal 17(7), 2001: 99-104  
 13. No MDP adhesive cement

Contact: Dr. Ana Petre  
 ana.petre@dental-studio.ro