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Adhesive cementation protocol of Zirconia restorations

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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), Zirox (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 µm 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 µm particles, in order to improve the bonding between a non-MDP resin cement like Relyx ARC® and zirconia surface.

Zirconia	Sand blasting	Presure	Silicatisation	Silanisation	Adhesive Cement self/adhesive
IPS ZirCAD[1] Ivoclar	Al_2O_3	1 bar	NO	Monobond Plus® Ivoclar	Variolinkv II (Ivoclar) Multilink® (Ivoclar) SpeedCEM® (Ivoclar)
Cercon[2] Dentsply	50 50µm Al_2O_3	2-3 bar	NO	Prime&Bond NT® (Dentsply)	Calibra Esthetic Resin Cement® (Dentsply)
Zirox Wieland	Al_2O_3	1 bar	NO	ED Primer A,B® (Kuraray)	RelyX Unicem® (3M Espe) Panavia® F2.0 (Kuraray)
Procera Zirconia[2] Nobel Biocare	max. 100 µmAl_2O_3	2.5 bar	NO	Alloy Primer® (Kuraray)	Panavia® 21TC (Kuraray) RelyX Unicem® (3M Espe)
Ceramill[4] Amann Girrbach	110 µm Al_2O_3	1 bar	NO	Monobond Plus® (Ivoclar)	Multilink® (Ivoclar)
Lava[5]	Al_2O_3 + SiO_2	≥ 2.8	YES	Espe Sil® (3M Espe)	RelyX&tm; ARC® (3MEspe)*

3M Espe		bar	NO	NO	RelyX unicem® (3M Espe)
inCoris[6] Sirona	50 µm Al_2O_3	≤ 2.5 bar	NO	NO	Panavia® F2.0 (Kuraray) Panavia® 21TC (Kuraray)
inVizion[7] Vita	max. 50 µm Al_2O_3	2.5 bar	NO	NO	Panavia® F2.0 (Kuraray9 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-methacryloyloxydecyl-dihydrogenphosphate (MDP) (fig. 1). The acidic phosphate groups of this monomer have the property to combine directly with metal oxides 8 as ZrO_2, Al_2O_3, 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_2O_3 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).

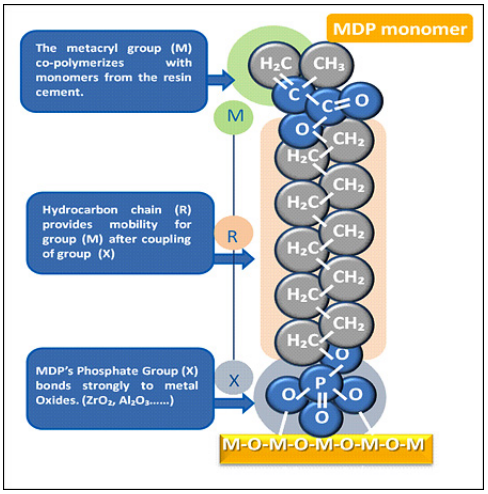


Fig. 1: MDP monomer - chemical structure

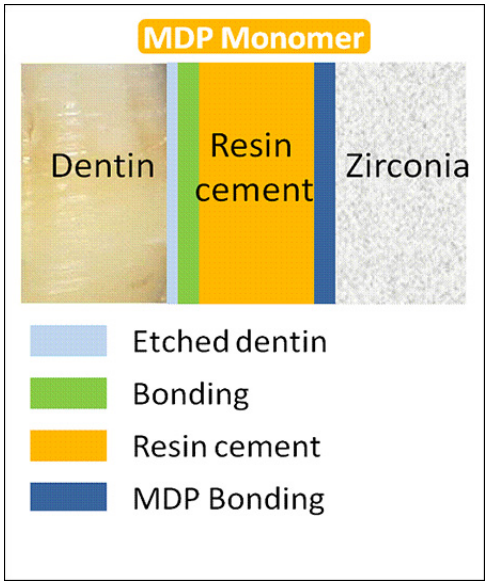
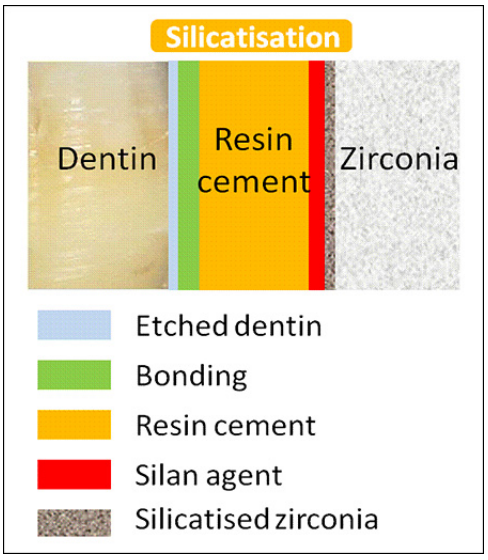


Fig. 2a: Successive layers between dentin and zirconia surface in MDP cementation/silicatisation



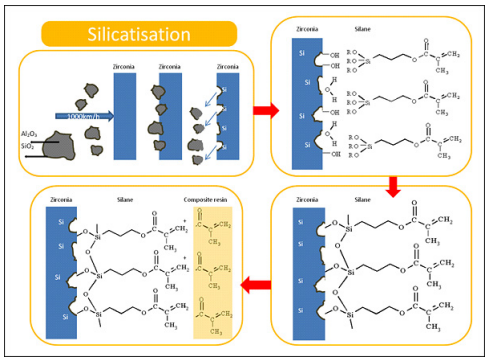


Fig. 2b: Successive layers between dentin and zirconia surface in MDP cementation/silicatisation

Fig. 3: Silicatisation process

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Poster Faksimile: