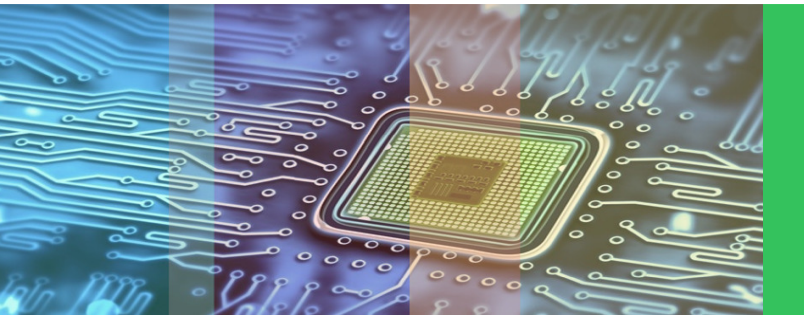
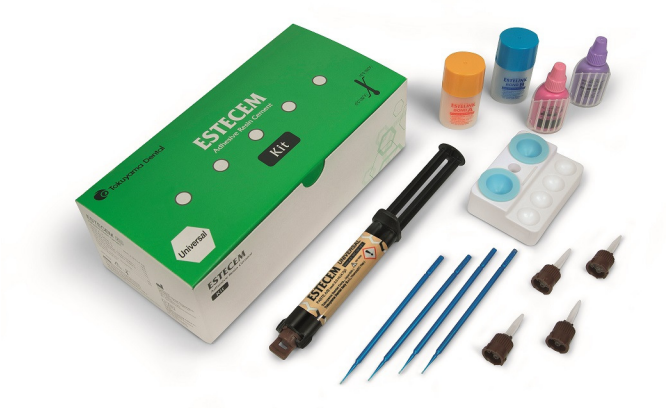
Estecem

Tokuyama Dental **TECHNICAL REPORT**





ESTECEM - TECHNICAL REPORT

Tokuyama Dental

Via dell'Artigianato,7 - 36030 Montecchio Precalcino (VI) - ITALY
Tel. 0445 334545 - Fax. 0445 339133
Email. info@tokuyama.it - segreteria@tokuyama.it
www.tokuyama.it

index

1 Introduction

1.1 DEVELOPMENT BACKGROUND

In today's market, self-adhesive type resin cements (hereinafter referred to as SA cements) that require no pre-treatment of the tooth substance or prosthetics are taking an increasingly large share of that market. However, the following questions about these SA cements require an answer:

1) Can strong adhesion, especially to the tooth substance, be achieved without pre-treatment?
2) The proportion of acid monomers and/or hydrophilic monomers (e.g., HEMA) should be increased to achieve adhesion to the tooth substance. Can excellent esthetic properties also be achieved in light of the increased proportion of these monomers?

We then evaluated the adhesion of different SA cements to the tooth substance. Each SA cement was cured by chemical polymerization, based on the assumption that these cements may be used under light-shielding conditions. As shown in *Table 1*, the results revealed the adhesive strength of all the SA cements to the tooth substance was obviously lower than that achieved with Bistite II DC, which requires pre-treatment.

Table 1 *Adhesion of SA cements to the tooth (tensile bond strength)*

	dentin		enamel	
	initial bond strength (MPa)	bond strength after durability test (MPa)	initial bond strength (MPa)	bond strength after durability test (MPa)
RelyX Unicem 2	5.3 (0.9)	4.6 (5.2)	7.3 (1.4)	0.8 (0.5)
SA Cement Plus	4.5 (0.4)	2.4 (2.5)	5.2 (1.9)	1.8 (0.8)
Maxcem Elite	2.4 (0.5)	1.4 (0.3)	7.3 (2.4)	1.3 (0.2)
G-CEM LinkAce	4.8 (0.8)	1.0 (0.6)	2.0 (0.1)	0.5 (0.1)
Speed CEM	3.9 (2.9)	1.3 (0.2)	5.0 (3.2)	1.0 (0.6)
BifixSE	1.2 (0.1)	0.9 (0.2)	3.3 (1.8)	1.2 (0.3)
Bistite II DC	16.7 (2.2)	14.1 (4.1)	23.0 (3.2)	21.9 (2.3)

Durability Test: 3,000 cycles of a thermal cycling test (4°C 60°C, dwell time of one minute)

Table 2 summarizes the water sorption and the solubility of SA cements. *Table 3* summarizes the results of a staining test with coffee. The results indicate that all SA cements, when compared to Bistite II DC, absorb greater amounts of water and were more soluble, and that their performance in the coffee staining test was significantly inferior to that of Bistite II DC.

Table 2 *Water sorption and solubility of SA cements*

	water sorption (μg/mm3)		solubility (μg/mm3)	
	chemical polymerization	photo polymerization	chemical polymerization	photo polymerization
RelyX Unicem 2	34	28	3.3	1.3
SA Cement Plus	34	31	3.4	1.5
Maxcem Elite	64	64	13.7	10.0
G-CEM LinkAce	30	29	0.9	1.0
Speed CEM	30	32	1.9	1.1
BifixSE	45	47	4.6	2.2
Bistite II DC	15	14	2.2	1.3

Table 3 *Staining test with coffee using SA cements*

	shade	ΔE
RelyX Unicem 2	A2	7.9
SA Cement Plus	Universal	18.6
Maxcem Elite	Yellow	11.9
G-CEM LinkAce	A2	10.2
Speed CEM	Yellow	14.6
BifixSE	Universal	16.6
Bistite II DC	Clear	8.1

Based on the above results, we at Tokuyama Dental Corp. decided that SA cement is not suitable for esthetic restoration involving ceramic or composite prosthetic materials. Tokuyama Dental Corp. markets Bistite II DC, which is a resin cement used for bonding between the tooth substance and prosthetics or between restorations. The adhesive strength of Bistite II DC is highly regarded [1,4]. However, Bistite II DC comprises of a three-bottle two-step pre-treatment agent for the tooth surface, dual-cure paste, and pre-treatment agents designated for different prosthetics (Ceramic Primer and Metaltite), which means that it is a complex system.

Thus, we started development of a cement, Estecem, which has superior handling characteristics and is suitable for esthetic restoration.

The development concept of Estecem is as follows:

1) Easy and reliable adhesion
2) Superior esthetics
3) Ease of use (especially easy removal of excess cement)

2 Composition and instructions

2.1 COMPOSITION

Estecem is comprised of Estelink, which consists of two liquids for pre-treatment of the tooth substance; Tokuyama Universal Primer, which consists of two liquids for pre-treatment of prosthetics; and Estecem Paste, which is a dual-cure paste. The composition of these agents is presented in *Tables 4.1-4.2- 4.3*.

Estelink contains the following: adhesive monomer "3D-SR monomer" (phosphoric acid monomer) for demineralization of the tooth substance and enhanced adhesion via interaction with tooth calcium; several monomers (HEMA, Bis-GMA, and TEGDMA) to form layers; acetone, isopropyl alcohol, and water as solvents; and a borate catalyst and peroxide as polymerization initiators.

Tokuyama Universal Primer contains the following: 6-methacryloyloxyhexyl 2-thiouracil-5-carboxylate (MTU-6), γ-methacryloxypropyl trimethoxy silane (γ-MPS), New 3D-SR monomer (phosphoric acid monomer), and 11-methacryloxy-1,1-undecanedicarboxylic acid (MAC-10), which are adhesive monomers for adhesion to various prosthetics; several monomers (Bis-GMA, TEGDMA, and UDMA) to form layers; and acetone and ethanol as solvents.

Estecem Paste contains the following: multifunctional monomers (Bis-GMA, TEGDMA, and Bis-MPEPP) as matrix monomers; silica-zirconia filler as a filler (filler loading: 74% weight); and camphorquinone and peroxide as polymerization initiators. It was designed without acid monomers that lead to discoloration for long-lasting esthetics.

Table 4.1 *Composition of Estelink, a pre-treatment agent for tooth substance*

BOND A

basic components	function
Phosphoric acid monomer	Demineralization of tooth substance, Formation of bonding layer
HEMA	Penetration into the tooth substance, Formation of bonding layer
Bis-GMA	Formation of bonding layer
TEGDMA	Formation of bonding layer
Acetone	Solvent

BOND B

basic components	function
Borate	Polymerization catalyst
Peroxide	Polymerization catalyst
Acetone, Isopropyl alcohol	Solvent
Water	Demineralization of tooth substance

Table 4.2 *Composition of Tokuyama Universal Primer, a pre-treatment agent for prosthetics*

PRIMER A

basic components	function
MTU-6	Adhesion for precious metal
γ-MPS	Adhesion for glass ceramics and resin composite
Bis-GMA	Formation of primer layer
TEGDMA	Formation of primer layer
Ethanol	Solvent

PRIMER B

basic components	function
Phosphoric acid monomer (New 3D-SR monomer)	Adhesion for zirconia
MAC-10	Adhesion for non-precious metal
UDMA	Formation of primer layer
Acetone	Solvent

Table 4.3 *Composition of Estecem Paste, a paste agent*

PASTE A

basic components	function
Bis-GMA	Matrix Monomer
TEGDMA	Matrix Monomer
Bis-MPEPP	Matrix Monomer
Silica-Zirconia Filler	Filler (Filler Loading: 74% weight / 61% volume)

PASTE B

basic components	function
Bis-GMA	Matrix Monomer
TEGDMA	Matrix Monomer
Bis-MPEPP	Matrix Monomer
Silica-Zirconia Filler	Filler (Filler Loading: 74% weight / 61% volume)
Camphorquinone	Polymerization catalyst
Peroxide	Polymerization catalyst

2.2 SHADES

Estecem is available in the four shades shown below.

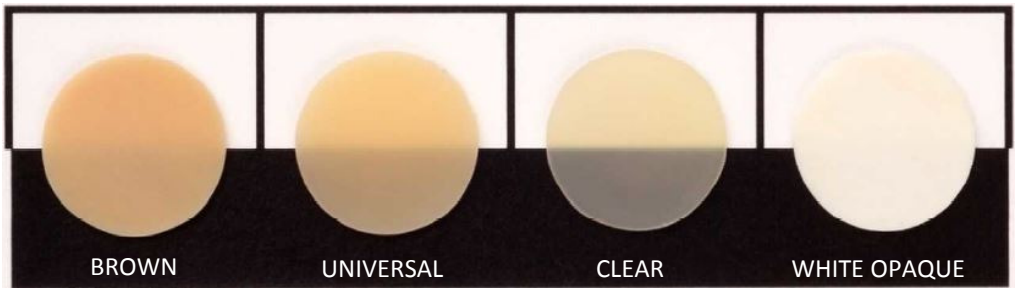


Figure 1 *Available In four shades*

1) Universal :
A common tooth color shade that is ideal for Anterior Esthetic Restorations, and generally a wide range of shade-matching cases. Universal shade is included in the Kit.

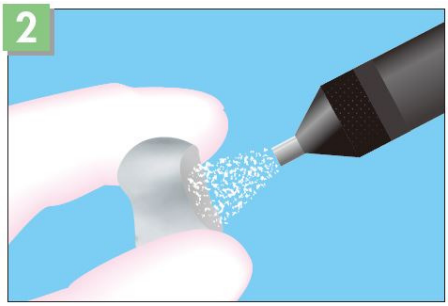
2) Clear :
A colorless and transparent shade that is suitable for Esthetic Crown and Veneers where the underlying tooth color provides most of the color needs.

3) Brown :
A dentin color shade that is suitable for ceramic or composite resin crowns.

4) White-Opaque :
A shade with high opacity that is suitable for veneer and other cases requiring masking of the underlying color.

2.3 INSTRUCTIONS

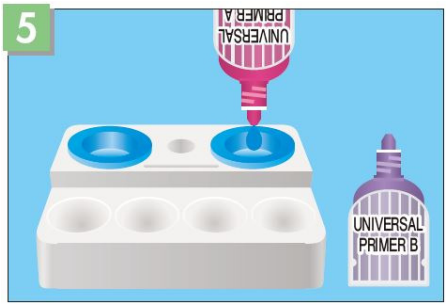
1. Tooth preparation
Remove contamination from the tooth surface such as plaque, temporary cement residue, oil from materials to test crown fit, oil mist from a hand-piece, saliva, blood and exudate fluids by brushing with flour pumice, ultrasonic scaling or cleaning the surface of the tooth with alcohol.
Thoroughly rinse and dry the surface



2. Restoration preparation
depending on the material to be restored
1 **Ceramics other than Porcelain, and Composite materials**: roughen the interior of the restoration by sandblasting (0.1 to 0.2MPa), air abrasion or grinding with a diamond bur using a slow speed to prepare the surface for adhesion
2 **Porcelain**: do not roughen the surface; prepare the interior of the restoration, providing a clean and fresh surface for adhesion
3 **Metal restorations**: roughen the area by sandblasting (0.3 to 0.5MPa), air abrasion or grinding with a diamond bur using a slow speed to prepare the surface for adhesion

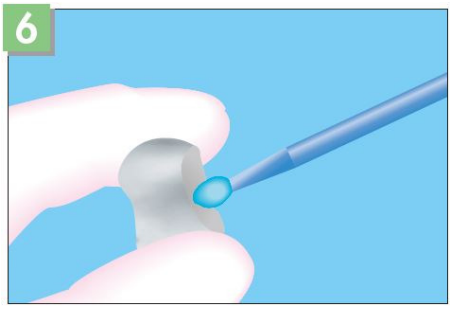
3. Thoroughly rinse the surface

4. Dry the surface



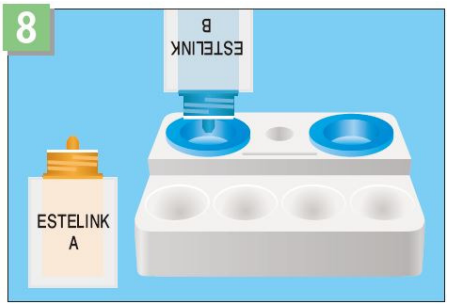
5. Restoration pretreatment with the Tokuyama Universal Primer

Dispense one drop each of Tokuyama Universal Primer A and B into the dispensing well and mix



6. Apply the mixed primer on the surface to be bonded and wait 10 seconds

7. Apply mild air to the surface



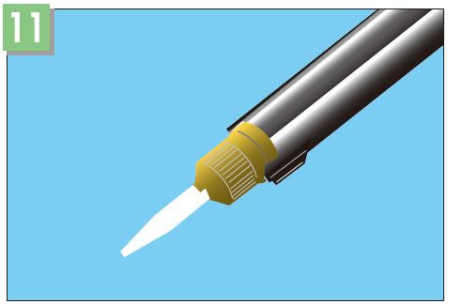
8. Tooth Pretreatment with the Estelink

Dispense one drop of Estelink Bond A and Bond B into the dispensing well and mix

* Complete the application within 1 minute after dispensing

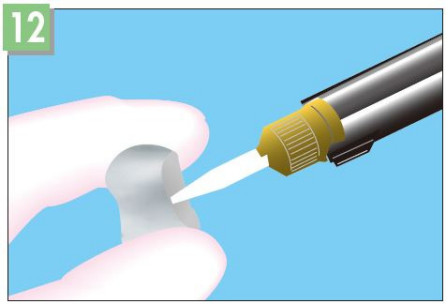
9. Apply the mixed Estelink on the surface to be bonded and wait 10 seconds

10. Apply mild air continuously to the surface until the runny Estelink stays in the same position without any movement, then strong air to the surface



11. Cementation and Final Bonding

Attach a mixing tip to the syringe according to "How to attach the mixing tip"



12. Apply the mixed Paste to the surface of the restoration and place the restoration on the tooth with firm pressure

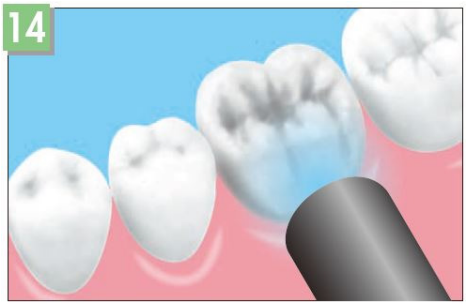
13. Removal of excess Paste

- **when using the light-cure method**:

Light-cure the excess PASTE with a dental curing light for 2 to 4 seconds and remove the gel state of the excess Paste

- **when using the self-cure method**:

Remove the gel state of the excess Paste within 1 to 3.5 minutes after seating



14. Final Paste hardening by light curing

- **in case of translucent restoration materials such as ceramics**:

irradiate the light to the applied Paste on the seated restoration for 20 seconds or more

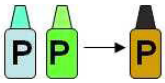
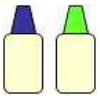
- **in case of non translucent restoration materials such as metal:**

light-cure along margins for 20 seconds or more, then allow the PASTE to set for 8 minutes

* If light curing is not enough, there is a possibility of poor adhesiveness.

Estecem achieves adhesion to any material by using Estelink, which is a two-bottle one-step pre-treatment agent for the tooth surface; and Tokuyama Universal Primer, which is a two-bottle one-step pre-treatment agent for prosthetics. Both of these pre-treatment agents are used in the same manner (mix → apply → leave for 10 sec. → air blow) and are easy to use in comparison with the systems of a number of manufacturers. Light irradiation of the cement paste is required for final curing to ensure adhesion.

Table 5 *Comparison of pre-treatment agents bundled with the cement systems of several different manufacturers*

<table>
<tr><th>product</th><th>Estecem</th><th>Bistite II</th><th>Clearfil Esthetic Cement EX</th><th>Panavia F2.0</th><th>RelyX Ultimate</th><th>Multilink Automixt</th></tr>
<tr><td>Teeth</td><td> 
10 sec</td><td> 
30 sec 20 sec</td><td> 
20 sec 10 sec</td><td> 
30 sec</td><td rowspan="6"></td><td> 
30 sec</td></tr>
<tr><td>Precious metal</td><td rowspan="5"> 
10 sec</td><td>  </td><td rowspan="2">  </td><td rowspan="2">  </td><td rowspan="5"> 
60 sec</td></tr>
<tr><td>Non-precious metal</td><td>No treatment</td></tr>
<tr><td>Ceramics</td><td rowspan="3">  </td><td rowspan="3">  </td><td rowspan="3">  </td></tr>
<tr><td>Indirect composite</td></tr>
<tr><td>Zirconia</td><td>No treatment</td></tr>
</table>

2.4 ADHESION MECHANISM

Estecem is available in the four shades shown below.

2.4.1 MECHANISM OF ADHESION OF ESTELINK

Estelink, which is the pre-treatment agent for the tooth substance used in conjunction with Estecem, enables reliable adhesion to the tooth due to the adoption of 3D-SR technology using a new 3D-SR monomer, and BoSE technology using a borate initiator. A detailed description is given below.

2.4.1.1 Mechanism of adhesion to the tooth substance

Tokuyama Dental Corp. developed 3D-SR technology to improve adhesion of the bonding agent Tokuyama Bond Force to the tooth substance[5, 6]. The 3D-SR monomer, having several functional groups that can interact with calcium and polymerizing groups per molecule *Figure 2*, interacts with calcium in the tooth substance at multiple points to create strong adhesion to the tooth structure surface. Further, three-dimensional cross-linking occurs via calcium, and copolymerization between adhesive 3D-SR monomers and other monomers contributes to the formation of a very strong bonding layer. *Figure 3*

In Estelink, a new adhesive SR monomer *Figure 2* has been developed by improving the above-mentioned SR monomer to enhance adhesion to the tooth substance. One molecule of the newly developed 3D-SR monomer contains more functional groups that can interact with calcium and polymerizing groups than the previous SR monomer. This has enhanced the above-mentioned effect, provided more cross-linking points for calcium in the tooth substance, and resulted in a stronger structure through three-dimensional cross-linking reactions. Estelink, when used in conjunction with this new 3D-SR monomer, creates a higher density of adhesion points to the tooth structure surface and more three-dimensional cross-linking reactions; therefore, it provides reliable adhesion to the tooth substance.

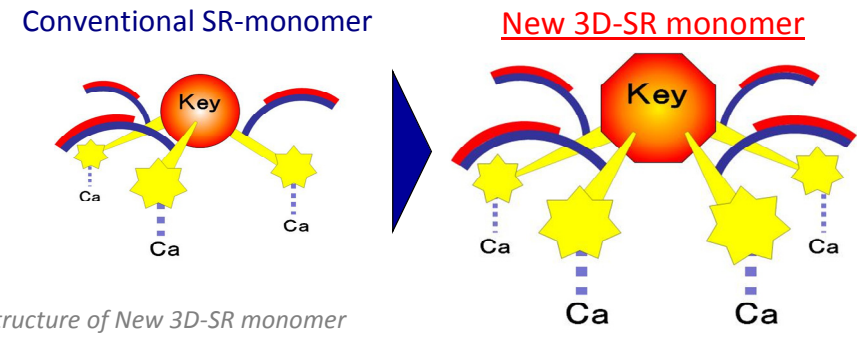


Figure 2 *Structure of New 3D-SR monomer*

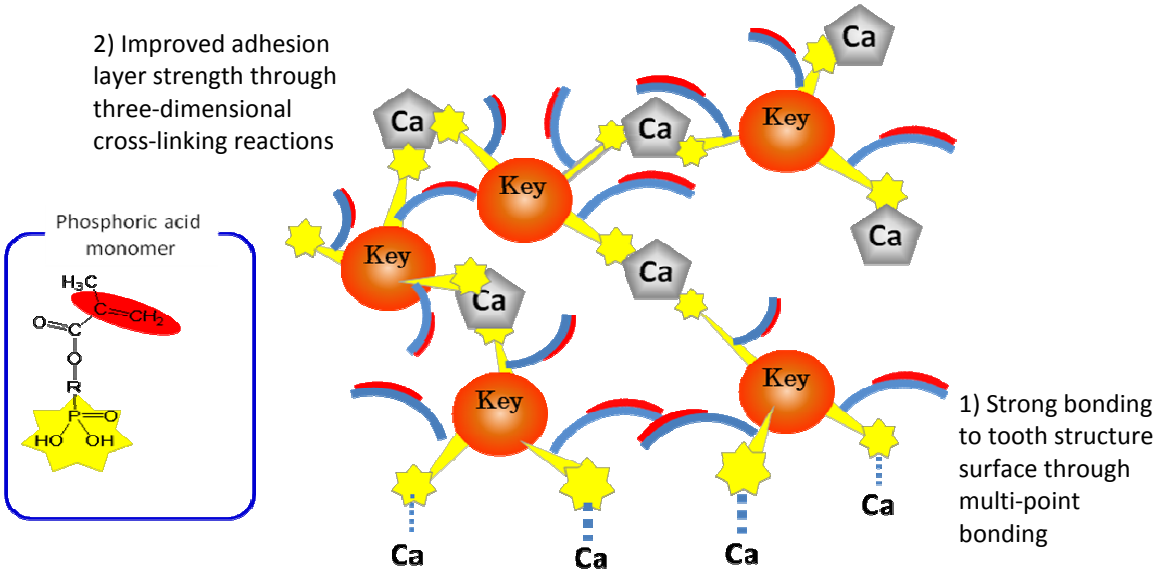


Figure 3 *Three-dimensional cross-linking reactions of adhesive SR monomers and calcium*

2.4.1.2 Mechanism of polymerization initiator

Estelink employs BoSE technology with a borate initiator. The borate initiator is decomposed by acid (phosphoric acid monomer) and transformed into a borane compound which produces free radicals. In addition, Estelink contains a peroxide that accelerates degradation of the borane compound and serves as a highly active chemical polymerization initiator *Figure 4*. BoSE technology is superior to the conventional chemical polymerization initiator, a benzoyl peroxide/amine system, because it exhibits high catalytic activity under strongly acidic conditions. Thus, the adhesion layer formed after air blow becomes very hard and provides strong adhesion to the tooth substance.

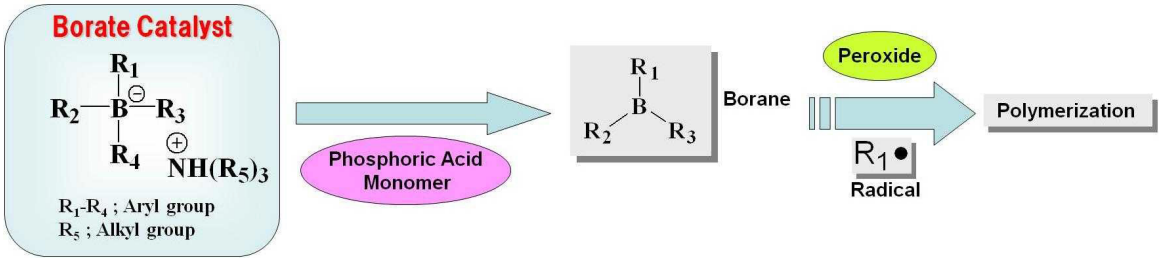


Figure 4 *BoSE Technology*

2.4.2 MECHANISM OF ADHESION OF UNIVERSAL PRIMER

Tokuyama Universal Primer contains the following adhesion monomers that are effective for a range of prosthetics: MTU-6 (for adhesion to precious metals), MAC-10 (for adhesion to non-precious metals), γ-MPS (for adhesion to glass ceramics and resin composite), and New 3D-SR monomer (for adhesion to zirconia/alumina). The mechanism of adhesion to each prosthetic is described in detail below.

2.4.1.1 Mechanism of adhesion to precious metal

The adhesive monomer for precious metal is MTU-6. As shown in *Figure 5*, the sulfur atom in the thiouracil group of MTU-6 interacts with precious metal (covalent bond) and additionally, the methacryl group co-polymerizes with monomers in dental-curable material (resin cements, bonding agents, resin composites, etc.) for adhesion.

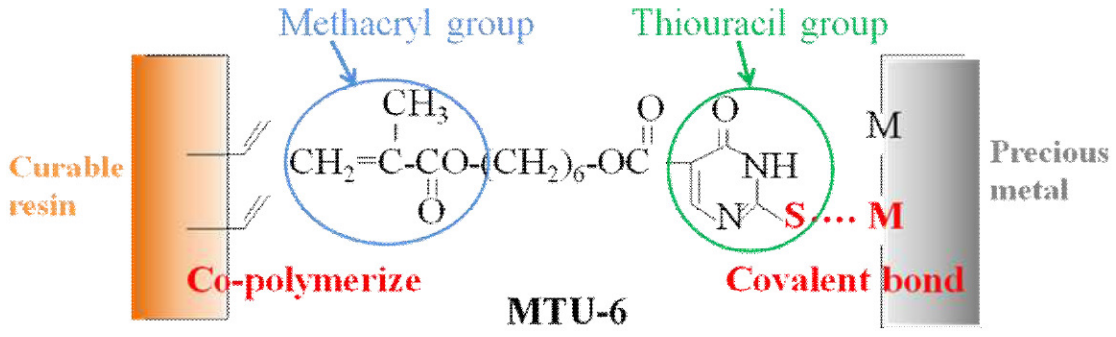


Figure 5 *Mechanism of adhesion to precious metal*

2.4.1.2 Mechanism of adhesion to non-precious metal

The adhesive monomer for non-precious metal is MAC-10. As shown in *Figure 6*, the carboxyl group of MAC-10 interacts with the oxygen atom of the passive layer of a non-precious metal surface (hydrogen bond) and additionally, the methacryl group co-polymerizes with monomers in dental curable material (resin cements, bonding agents, resin composites, etc.) for adhesion.

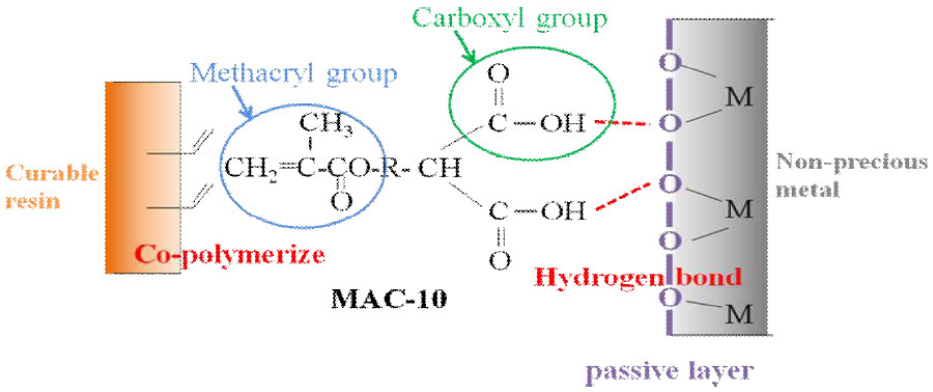


Figure 6 *Mechanism of adhesion to non-precious metal*

2.4.1.3 Mechanism of adhesion to glass-ceramics/resin

The adhesive monomer for glass-ceramics, porcelain and resin materials including inorganic filler is the silane coupling agent, γ-MPS. First, the alkoxy group in γ-MPS reacts with water to form a silanol group *Figure 7* and next, a siloxane bond is formed by a dehydration and condensation reaction with the silanol group on the ceramic surface. Additionally, the methacryl group co-polymerizes with monomers in dental curable materials (resin cements, bonding agents, resin composites, etc.) for adhesion. *Figure 8*

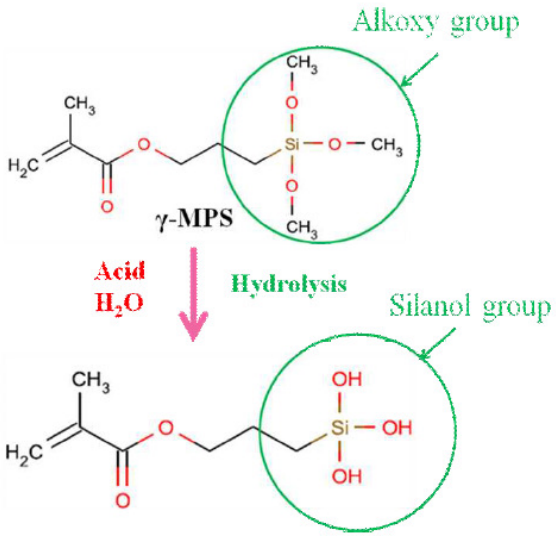


Figure 7 *Hydrolysis of γ-MPS*

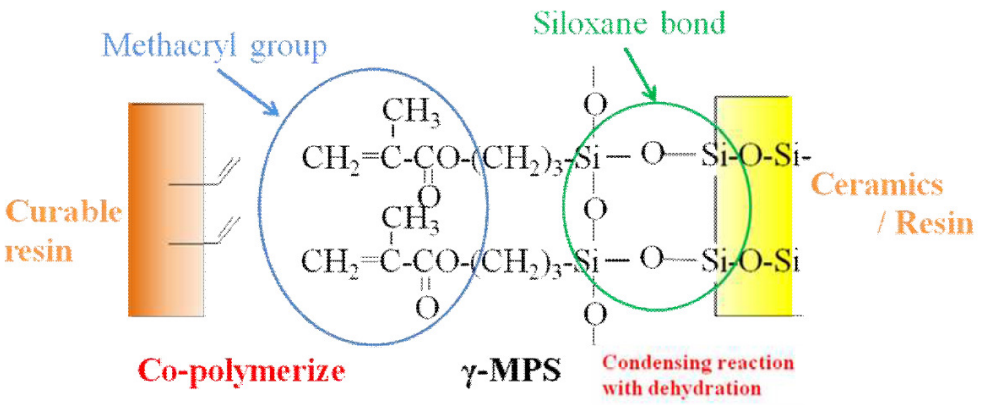


Figure 8 Mechanism of adhesion to glass-ceramics/resin materials including inorganic filler

2.4.1.4 Mechanism of adhesion to zirconia

The adhesive monomer for zirconia is the new 3D-SR monomer (phosphoric acid monomer). It is believed that the new 3D-SR monomer forms chemical bonds with the zirconia surface for adhesion. *Figure 9*

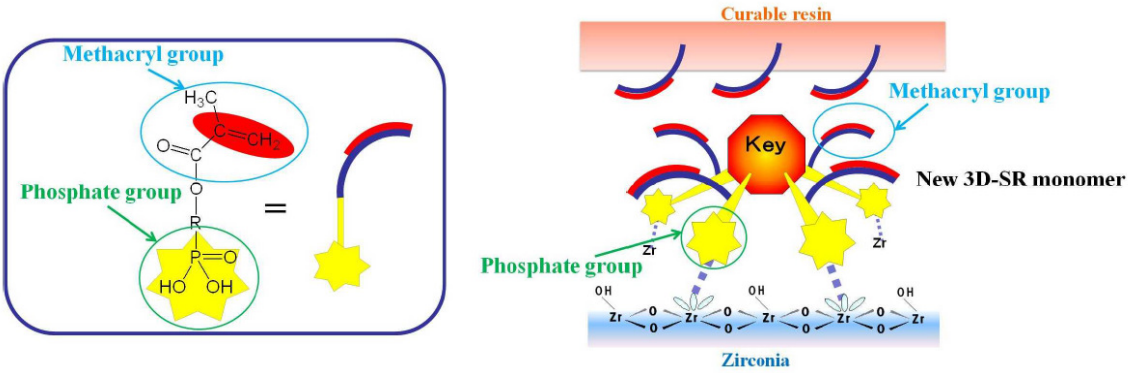


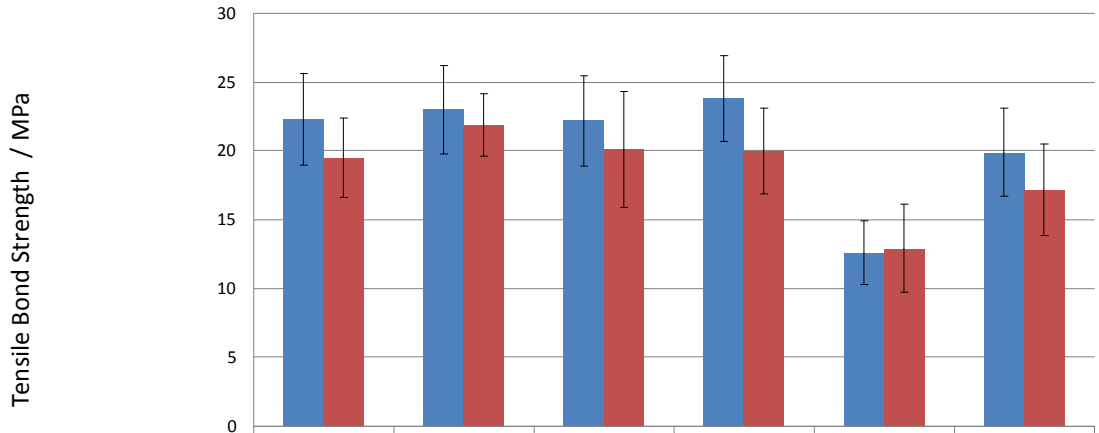
Figure 9 Mechanism of adhesion to zirconia

3 Characteristics

3.1 EASY AND RELIABLE ADHESION

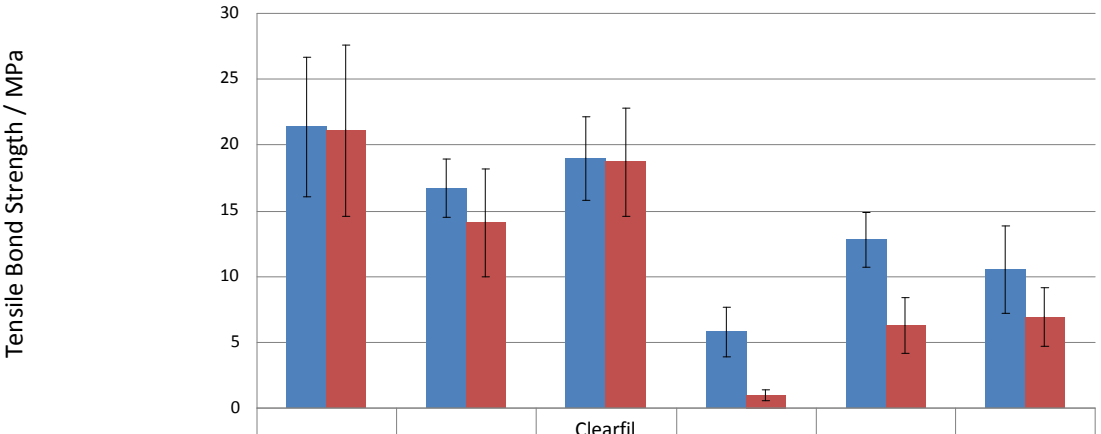
3.1.1 ADHESION OF ESTECEM TO THE TOOTH SUBSTANCE

The tensile bond strength of Estecem to the tooth substance was evaluated (initial bond strength and bond strength after durability test). The cement was cured by chemical polymerization, based on the assumption that it may be used under light-shielding conditions. As shown in *Graphics 1-2*, the results showed that Estecem had strong adhesion to both dentin and enamel. The results also demonstrated that Estecem had superior durability.



	ESTECEM	BISTITE II	Clearfil Esthetic Cement EX	Panavia F2.0	RelyX Ultimate	Multilink Automix
after 24 hours storage	22,3	23	22,2	23,8	12,6	19,9
after thermo-cycling (3.000 times)	19,5	21,9	20,1	20	12,9	17,2

Graphic 1 *Adhesive strength and adhesion durability of Estecem to enamel*

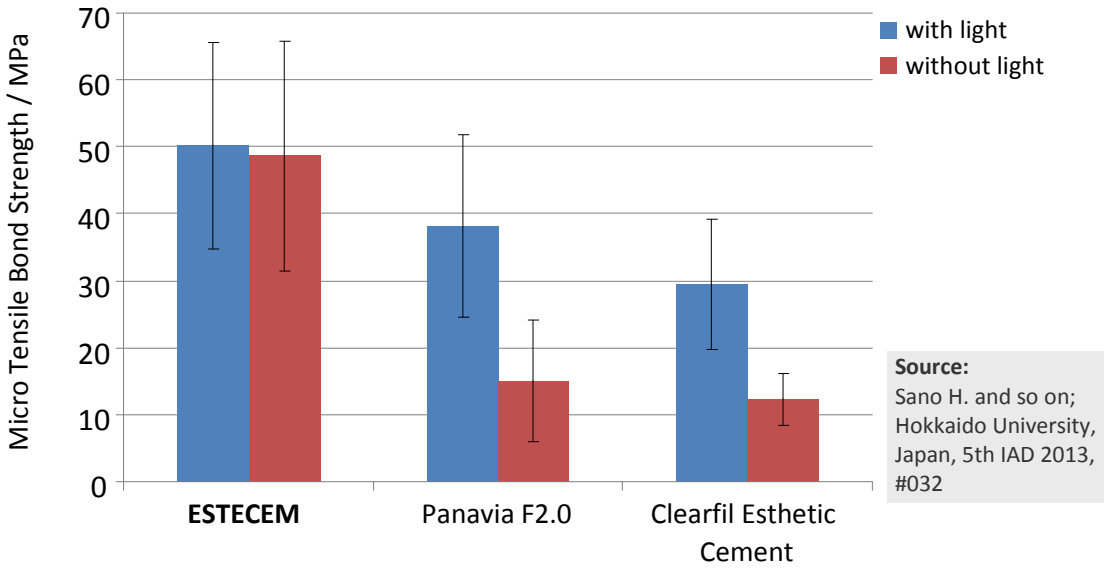


	ESTECEM	BISTITE II	Clearfil Esthetic Cement EX	Panavia F2.0	RelyX Ultimate	Multilink Automix
after 24 hours storage	21,4	16,7	19	5,8	12,8	10,5
after thermo-cycling (3.000 times)	21,1	14,1	18,7	1	6,3	6,9

Graphic 2 *Adhesive strength and adhesion durability of Estecem to dentin*

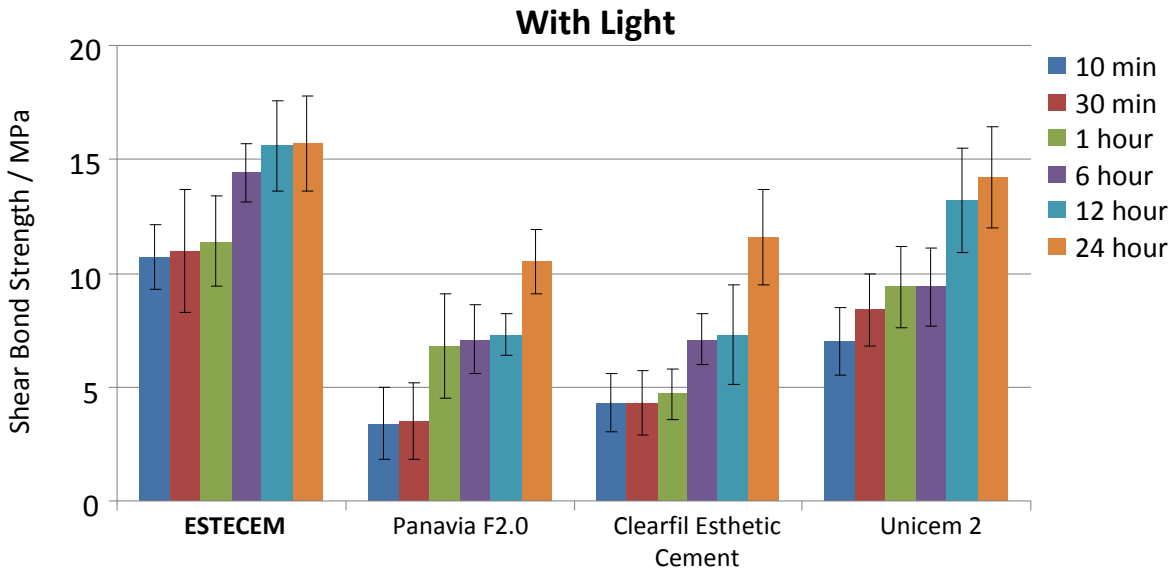
3.1.2 ADHESION OF ESTECEM TO THE TOOTH SUBSTANCE external data

External data on the adhesion of Estecem to the dentin were summarized. Estecem showed strong adhesion to the dentin with or without light irradiation of the cement paste (*Graphic 3*). Also, it exhibited adhesion more quickly than the products of other manufacturers and showed excellent adhesive strength to the dentin even at an early stage of curing (at 10 and 30 minutes after application). *Graphic 4*

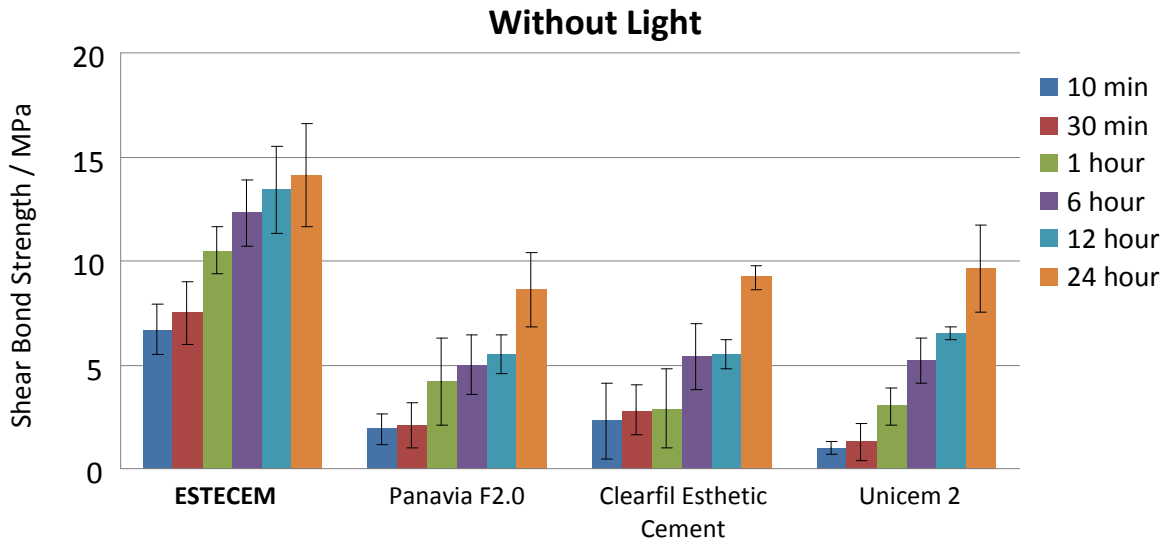


Source:
Sano H. and so on; Hokkaido University, Japan, 5th IAD 2013, #032

Graphic 3 *Adhesion of resin cements to dentin (external data 1)*



Source:
Miyazaki M. and so on; Nihon University, Japan, 139th Meeting of the Japanese Society of Conservative Dentistry 2013, #A3



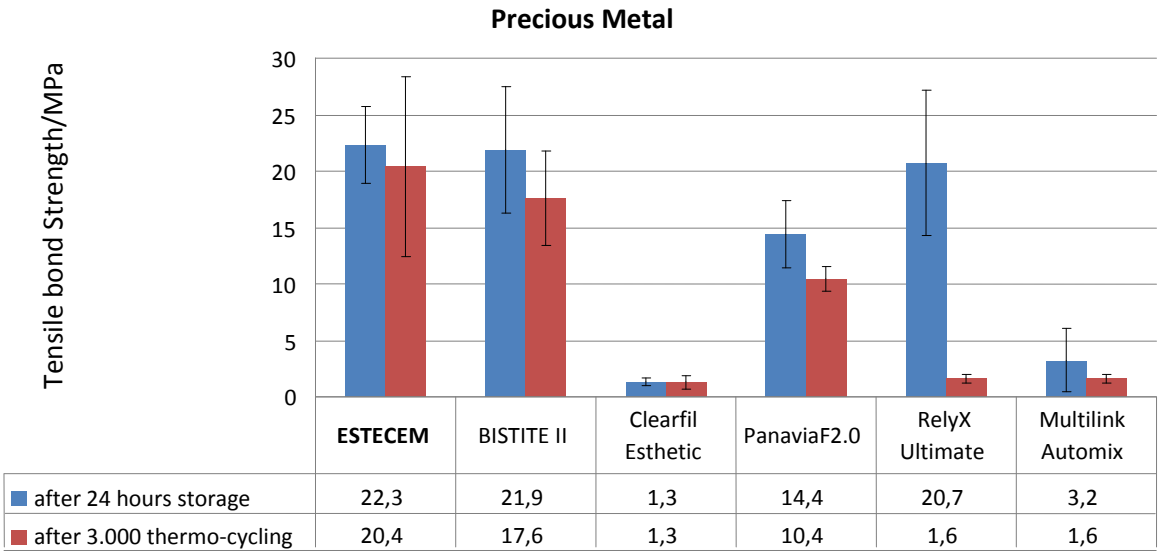
Graphic 4 *Change in bond strength of resin cements to dentin (external data 2)*

3.1.3 ADHESION OF ESTECEM TO PROSTHETICS

The adhesion of Estecem to prosthetics was evaluated. Cement paste was irradiated with light to ensure adhesion. The results showed that Estecem had excellent adhesive strength and adhesion durability for all the prosthetics tested. *Graphics 5-6-7-8-9*

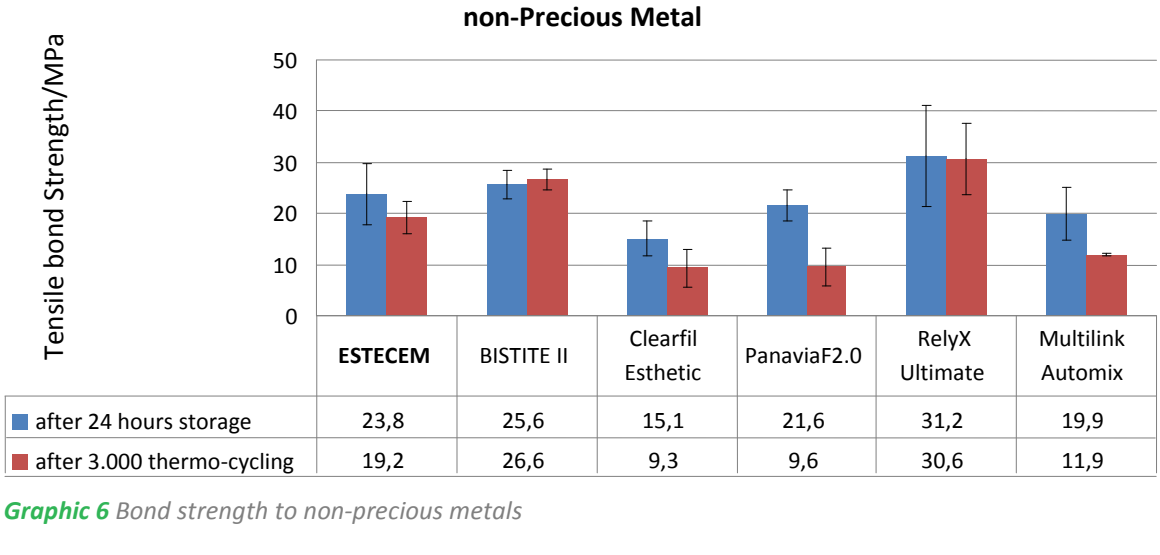
Table 6 *Prosthetics and pre-treatment methods*

	Manufacturer	Product name	Composition	Pre-treatment
Precious metal	Tokuyama Dental	CASTMASTER12S	Au12/Pd20/Ag54 /Cu12/other2	1. Grind with #1500 SiC 2. Sandblast (50um of Al2O3) 3. Leave for 1 week
Non precious metal	Tokuyama Dental	ICROME	Co57.8/Cr31.6/Mo5.6 /other5	1. Grind with #1500 SiC 2. Sandblast (50um of Al2O3) 3. Leave for 1 week
Ceramics (silica-base ceramics)	Kuraray Noritake Dental	Super Porcelain AAA	-	1. Grind with #800 SiC 2. Leave for 1 week
Indirect composite	Tokuyama Dental	PEARLESTE	-	1. Grind with #1500 SiC 2. Sandblast (50um of Al2O3) 3. Leave for 1 week
Zirconia	TOSO	TZ-3Y-E	Yttria stabilized Zirconia (Yttria 3%)	1. Grind with #120 SiC 2. Sandblast (50um of Al2O3) 3. Leave for 1 week



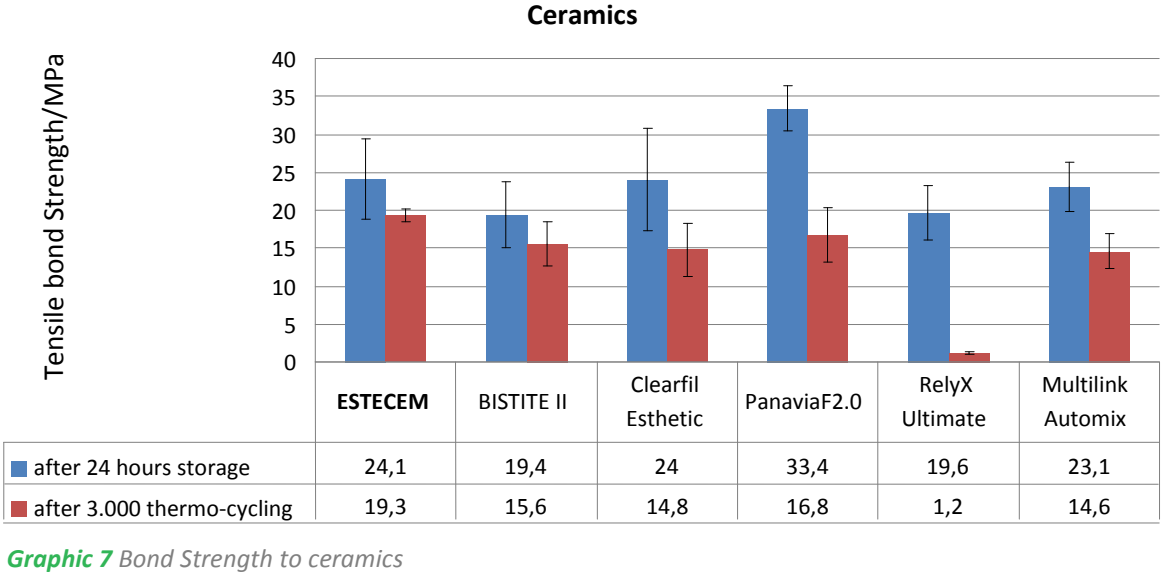
	ESTECEM	BISTITE II	Clearfil Esthetic	PanaviaF2.0	RelyX Ultimate	Multilink Automix
after 24 hours storage	22,3	21,9	1,3	14,4	20,7	3,2
after 3.000 thermo-cycling	20,4	17,6	1,3	10,4	1,6	1,6

Graphic 5 *Bond strength to precious metals*



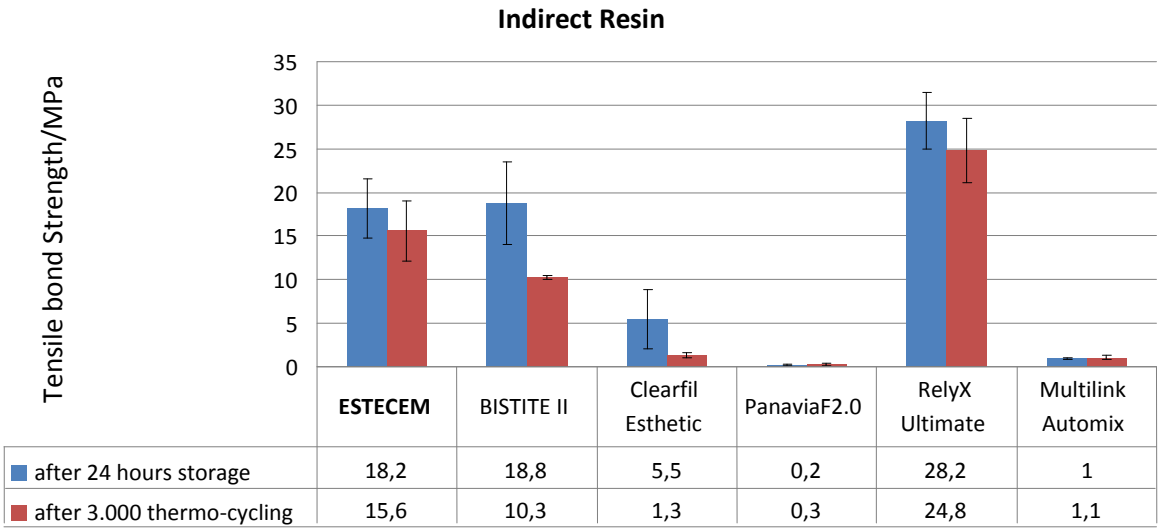
	ESTECEM	BISTITE II	Clearfil Esthetic	PanaviaF2.0	RelyX Ultimate	Multilink Automix
after 24 hours storage	23,8	25,6	15,1	21,6	31,2	19,9
after 3.000 thermo-cycling	19,2	26,6	9,3	9,6	30,6	11,9

Graphic 6 *Bond strength to non-precious metals*



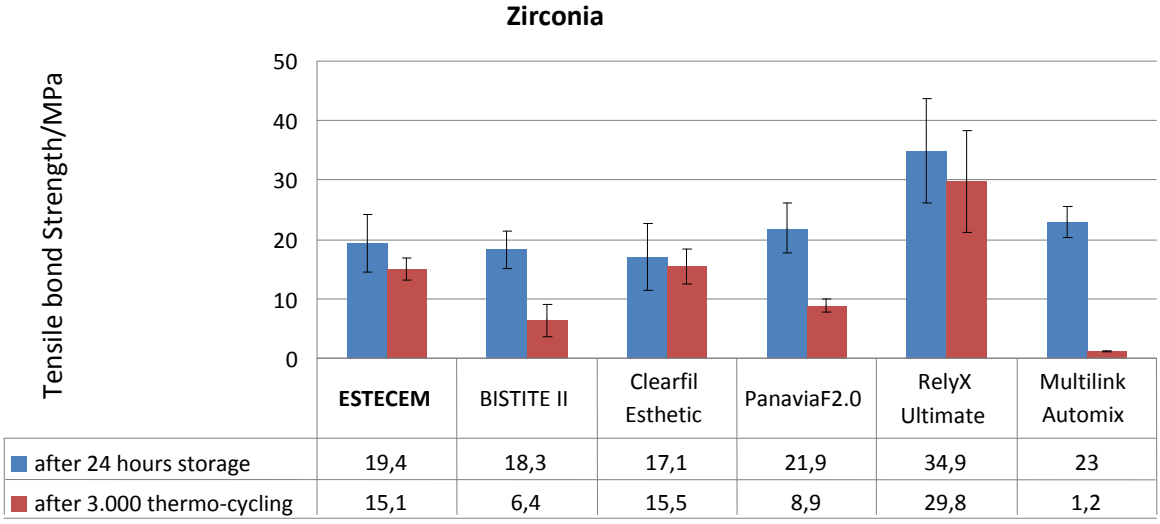
	ESTECEM	BISTITE II	Clearfil Esthetic	PanaviaF2.0	RelyX Ultimate	Multilink Automix
after 24 hours storage	24,1	19,4	24	33,4	19,6	23,1
after 3.000 thermo-cycling	19,3	15,6	14,8	16,8	1,2	14,6

Graphic 7 *Bond Strength to ceramics*



	ESTECEM	BISTITE II	Clearfil Esthetic	PanaviaF2.0	RelyX Ultimate	Multilink Automix
after 24 hours storage	18,2	18,8	5,5	0,2	28,2	1
after 3.000 thermo-cycling	15,6	10,3	1,3	0,3	24,8	1,1

Graphic 8 *Bond strength to indirect resins*



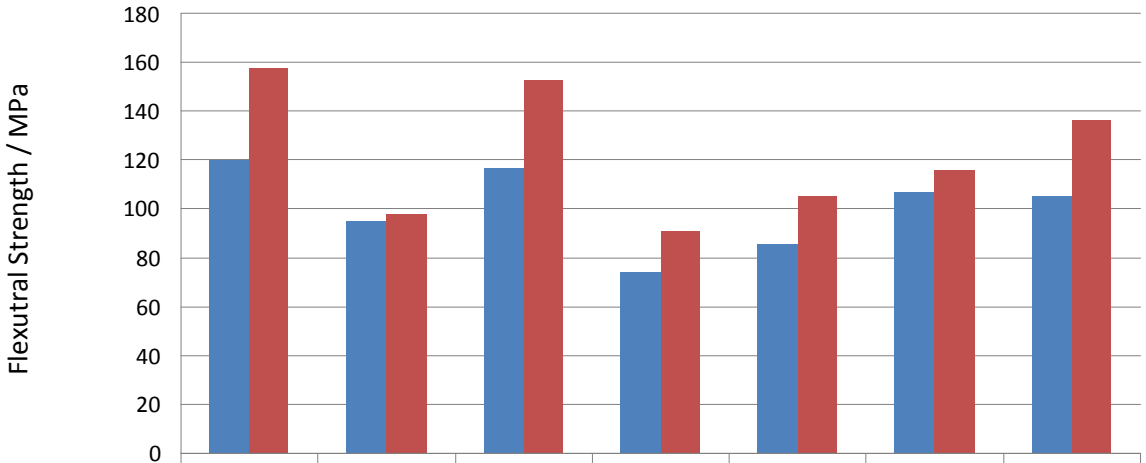
	ESTECEM	BISTITE II	Clearfil Esthetic	PanaviaF2.0	RelyX Ultimate	Multilink Automix
after 24 hours storage	19,4	18,3	17,1	21,9	34,9	23
after 3.000 thermo-cycling	15,1	6,4	15,5	8,9	29,8	1,2

Graphic 9 *Bond strength to zirconia*

3.2 SUPERIOR ESTHETICS

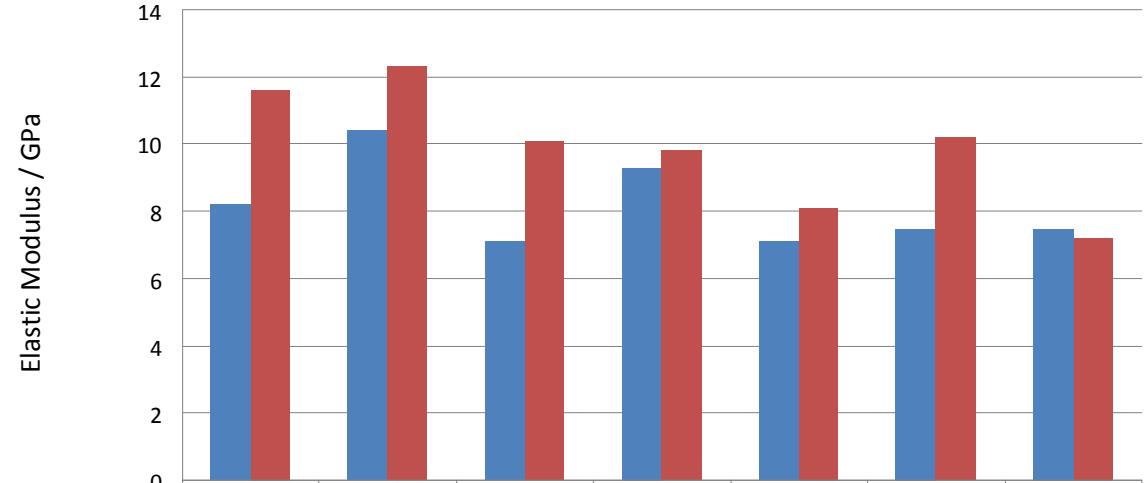
3.2.1 FLEXURAL STRENGTH AND ELASTIC MODULUS

The flexural strength and elastic modulus of cured Estecem paste were evaluated (*Graphics 10-11*). The evaluation method complied with ISO4049. The flexural strength and elastic modulus of Estecem were at least comparable or superior to those of other manufacturers. Increasing the strength of cured paste reduces abrasion at the margin and enables restoration to achieve better esthetic results.



	ESTECEM	BISTITE II	Clearfil Esthetic	Panavia F2.0	RelyX Ultimate	Variolink II	Multilink Automix
Chemical Cure	120	95	117	74	86	107	105
Light Cure	158	98	153	91	105	116	136

Graphic 10 *Flexural strength of Estecem*



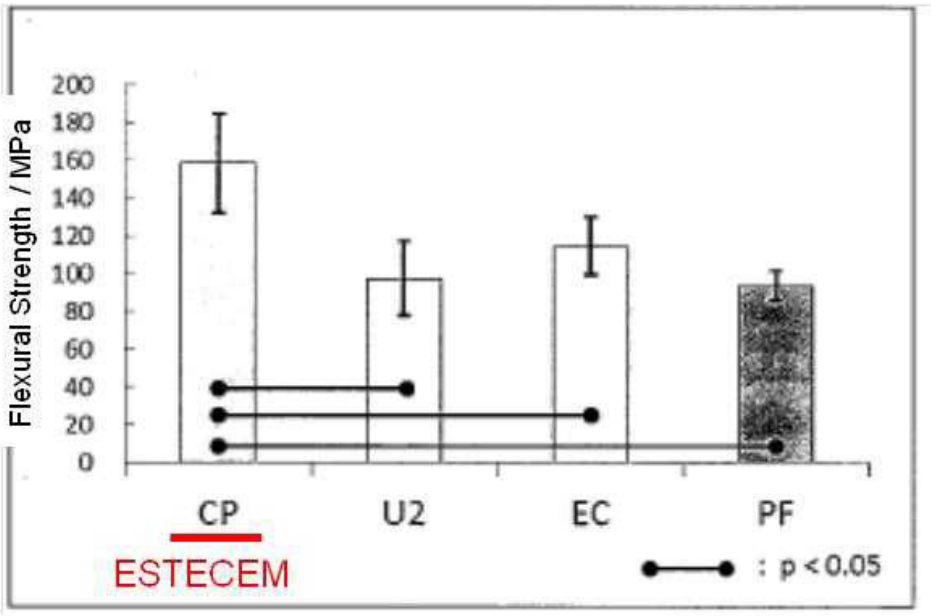
	ESTECEM	BISTITE II	Clearfil Esthetic Cement EX	Panavia F2.0	RelyX Ultimate	Variolink II	Multilink Automix
Chemical Cure	8,2	10,4	7,1	9,3	7,1	7,5	7,5
Light Cure	11,6	12,3	10,1	9,8	8,1	10,2	7,2

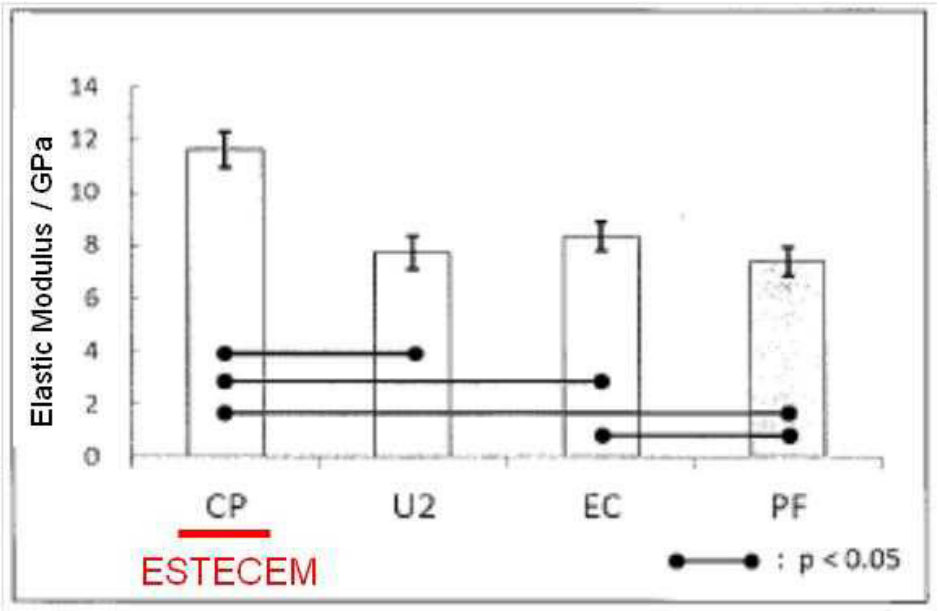
Graphic 11 *Elastic modulus of Estecem*

3.2.2 STRENGTH OF CURED RESIN external data

External data on the strength of cured Estecem paste were summarized. Estecem showed superior hardness when cured *(Graphic 12)*. The Vickers hardness of the irradiated

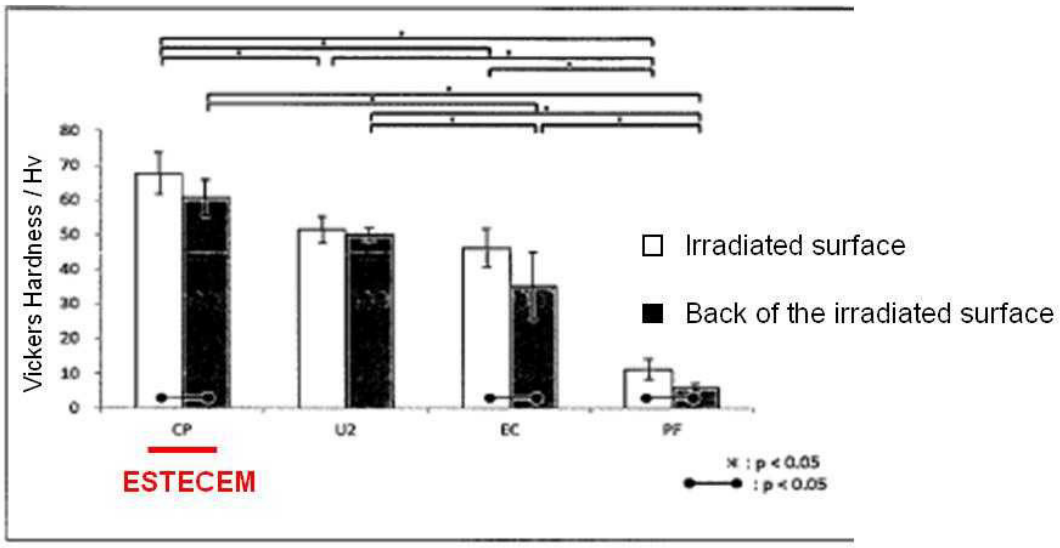
surface and the back of the irradiated surface was also high *(Graphic 13)*. Therefore, Estecem can be expected to have excellent long-term wear resistance at the margin.





CP:
ESTECEM / U2: RelyX Unicem2 / EC: Clearfil Esthetic Cement / PF: Panavia F2.0
Source: Miura H. and so on; Tokyo Medical and Dental University, Japan,
The 32nd Annual Meeting of Japanese Society for Adhesive Dentistry 2013, #P16

Graphic 12 *Hardness of cured resin cements (external data 3)*

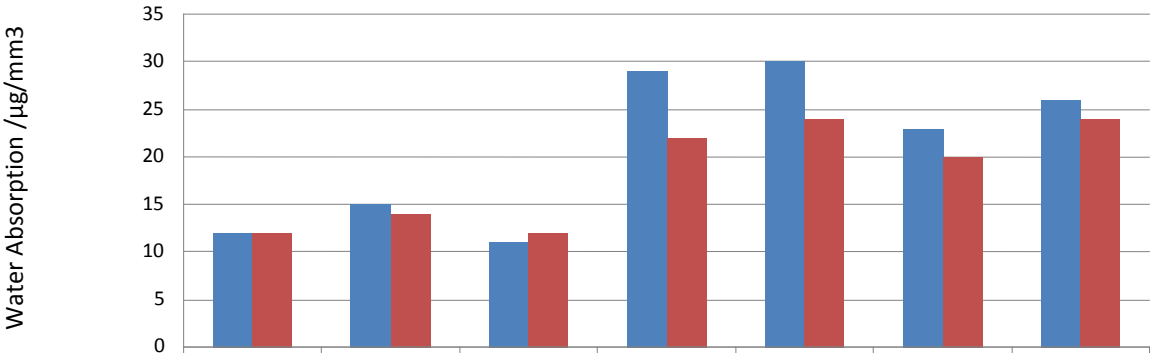


CP:
ESTECEM / U2 : RelyX Unicem2 / EC: Clearfil Esthetic Cement / PF: Panavia F2.0
Source: Miura H. and so on; Tokyo Medical and Dental University, Japan,
The 32nd Annual Meeting of Japanese Society for Adhesive Dentistry 2013, #P16

Graphic 13 *Vickers hardness of resin cements (external data 4)*

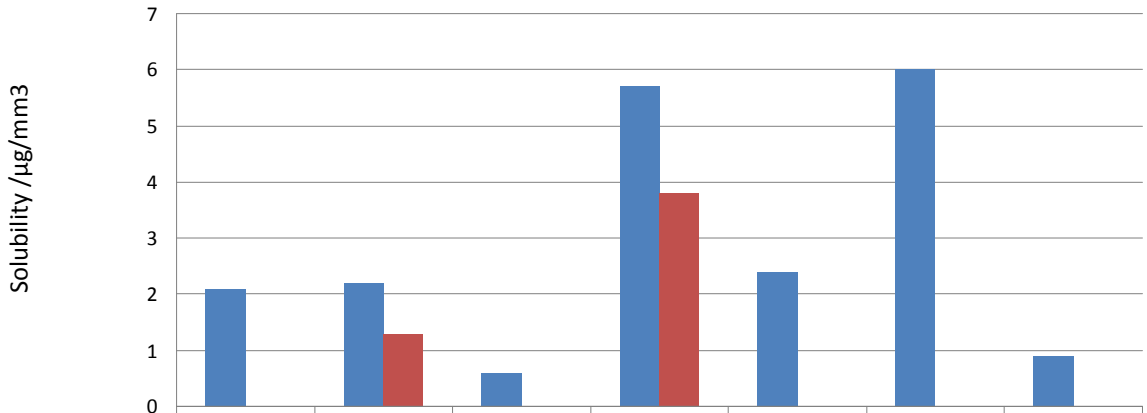
3.2.3 WATER SORPTION AND SOLUBILITY

The water sorption and the solubility of cured Estecem paste were evaluated *(Graphics 14-15)*. The evaluation method complied with ISO4049. The water sorption and the solubility of Estecem were both lower than the resin cements of other manufacturers, resulting in good adhesion durability, and anti-staining properties. Therefore, Estecem can be expected to demonstrate reliable adhesion and produce excellent esthetic results in long-term clinical use.



	ESTECEM	BISTITE II	Clearfil Esthetic	Panavia F2.0	RelyX Ultimate	Variolink II	Multilink Automix
Chemical Cure	12	15	11	29	30	23	26
Light Cure	12	14	12	22	24	20	24

Graphic 14 *Water sorption of Estecem*



	ESTECEM	BISTITE II	Clearfil Esthetic Cement EX	Panavia F2.0	RelyX Ultimate	Variolink II	Multilink Automix
Chemical Cure	2,1	2,2	0,6	5,7	2,4	6	0,9
Light Cure	0	1,3	0	3,8	0	0	0

Graphic 15 *Solubility of Estecem*

3.2.4 COLOR STABILITY

Staining tests with coffee and curry were performed for cured Estecem paste *(Tables 7-8)*. The results show that Estecem has superior anti-staining properties compared with the resin cements of other manufacturers. Therefore, Estecem can be expected to produce excellent esthetic results in long-term clinical use.

Table 7 *Results of staining test with coffee*

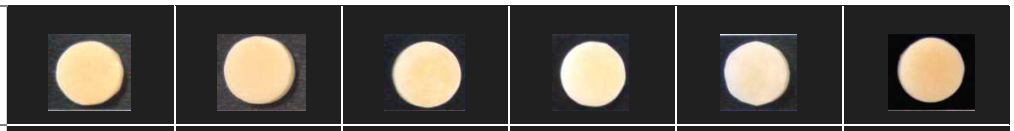
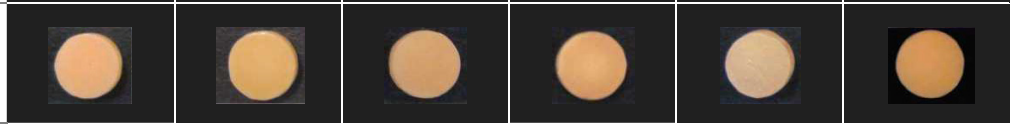
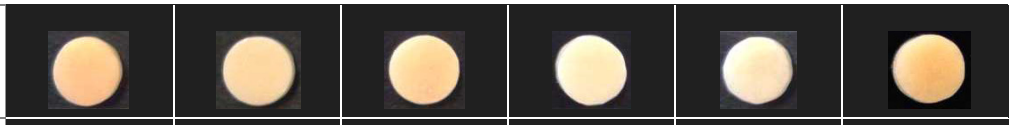
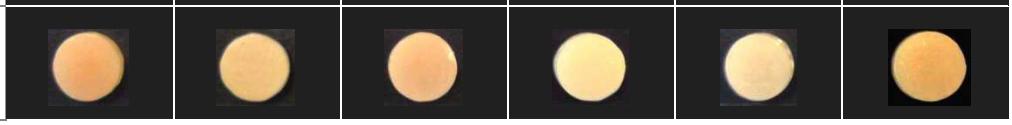
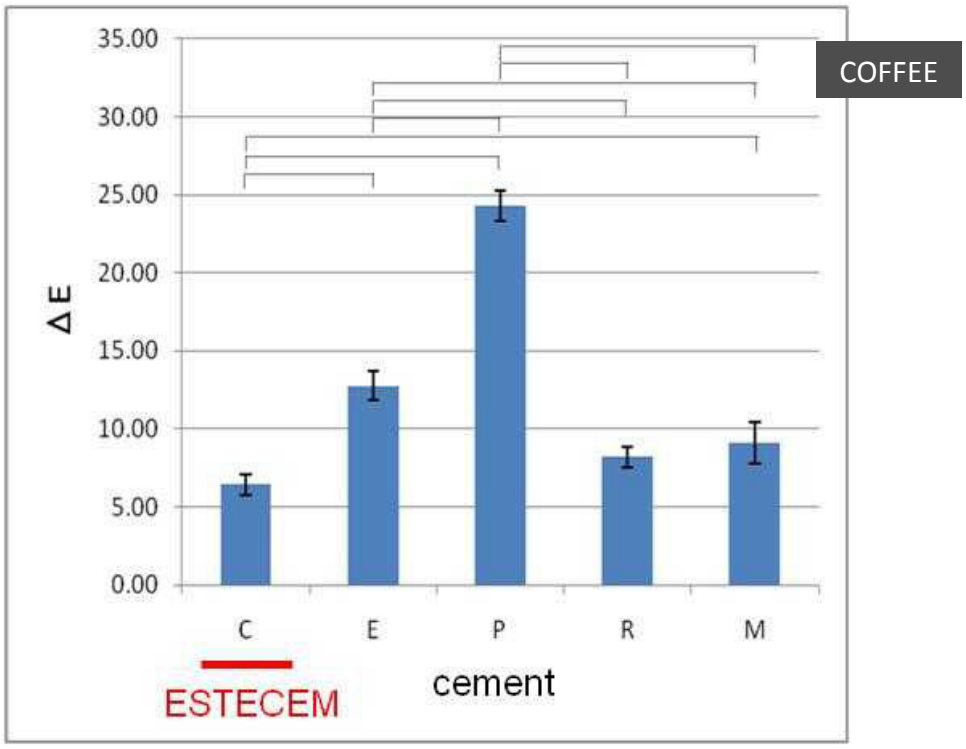
	ESTECEM	BISTITE II	CLEARFIL Esthetic Cement EX	Panavia F2.0	RelyX Ultimete	Multilink Automix
SHADE	UNIVERSAL	CLEAR	UNIVERSAL	LIGHT	A1	YELLOW
Before test						
After test						
ΔE	4.61	8.15	9.15	11.83	8.83	10.98

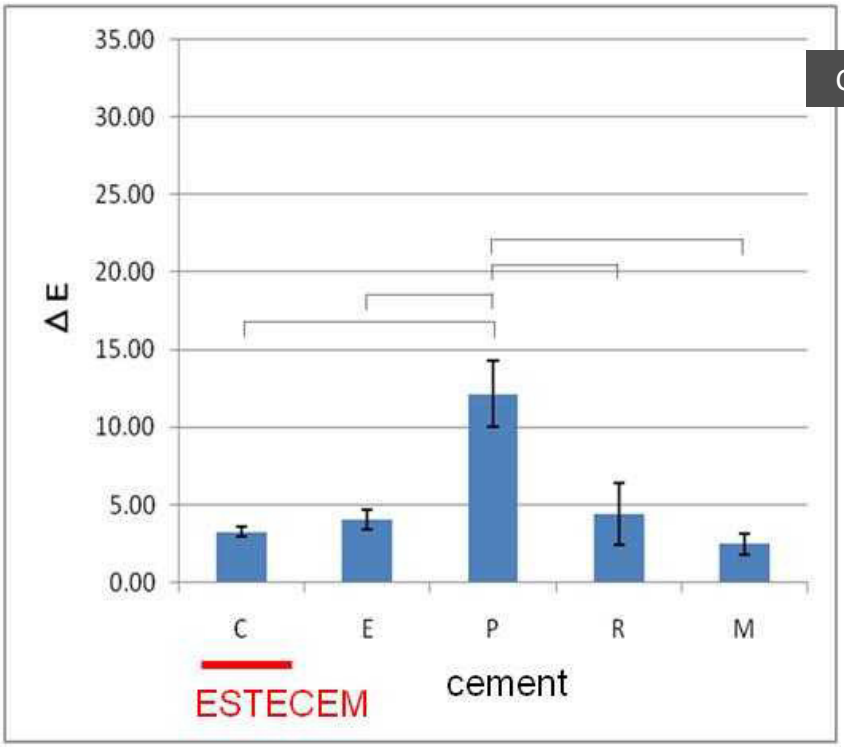
Table 8 *Results of staining test with curry*

	ESTECEM	BISTITE II	CLEARFIL Esthetic Cement EX	Panavia F2.0	RelyX Ultimete	Multilink Automix
SHADE	UNIVERSAL	CLEAR	UNIVERSAL	LIGHT	A1	YELLOW
Before test						
After test						
ΔE	6.55	8.14	8.45	8.40	9.48	8.94

3.2.5 COLOR STABILITY external data

External data on the color stability of Estecem paste were summarized. Estecem is superior in terms of its staining resistance against coffee and curry *(Graphic 16)*. Therefore, Estecem can be expected to produce excellent long-term esthetic results at the margin.





CP:
ESTECEM / E: Clearfil Esthetic Cement / P: Panavia F2.0 / R: Resicem / M: Multilink Automix
Source: Sato T. and so on; Tokyo Dental University, Japan,
The 21st Annual Meeting of Japan Academy of Esthetic Dentistry 2010, #P-34

Graphic 16 *Staining test of resin cements (external data 5)*

3.3 EASE OF USE

3.3.1 PHYSICAL PROPERTIES RELATED TO CEMENT HANDLING

The physical properties related to handling of Estecem paste were summarized *(Table 9)*. The evaluation method complied with ISO4049.

Table 9 *Prosthetics and pre-treatment methods*

	ESTECEM	BISTITE II	Clearfil Esthetic Cement EX	Panavia F2.0	RelyX Ultimate	Multilink Automix	Variolink II
Curing time (37°C)	4'30''	2'10''	4'40''	6'30''	2'40''	5'30''	4'40''
Working time (23°C)	2'40''	3'20''	5'50''	10'30''	4'10''	3'30''	50''
Radioacity	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Film Thickness /µm	10	6	20	21	7	9	8
Flowability /mm	0	18	0.5	2	1	0	0

3.3.2 REMOVABILITY OF EXCESS CEMENT

Estecem has been designed to provide "ample time for removal of excess cement." Regardless of the intensity of light used, excess cement can be removed over a prolonged period when using photopolymerization *(Table 10)*. It also gives sufficient time for removal with chemical polymerization *(Table 11)*.

Test procedure:

1. The labial side of an extracted bovine first front tooth was ground using silicon carbide paper (#600) to adjust the enamel.
2. The adjusted bovine tooth was then left to stand at 37°C under humid conditions for at least 1 hour.
3. Each cement paste (from different manufacturers) was mixed in accordance with the manufacturer's instructions, applied to the bovine tooth, and a piece of metal 1-mm square was pressed against the paste so that the paste protruded from the sides.
4. The tooth was shielded from light at 37°C under humid conditions for a preset period of time or irradiated with light to cure the cement.
5. Cement protruding from the sides of the metal piece was removed with a short needle.

○ : excess cement can be removed easily
△ : cement paste is soft/hard but can nevertheless be removed
× : cement paste is too soft/hard to be removed

Table 10 *Removability of excess cement (using photopolymerization)*

	Light Intensity mW/cm²	IRRADIATION TIME /sec.											
		1	2	3	4	5	6	7	8	9	10	11	12
ESTECEM	200	×	○	○	○	○	○	○	×				
	400	×	○	○	○	○	○	×					
	800	×	○	○	○	○	×						
BISTITE II	200	×	○	○	○	○	○	×					
	400	○	○	○	×								
	800	○	○	○	×								
Clearfil Esthetic Cement EX	200	×	○	○	○	×							
	400	○	○	×									
	800	○	×										
Panavia F2.0	200	×	○	○	○	○	○	○	○	○	×		
	400	×	○	○	○	○	○	○	×				
	800	○	○	○	○	○	○	×					
RelyX Ultimate	200	○	×										
	400	△	×										
	800	×											
Multilink Automix	200	△	○	×									
	400	○	○	×									
	800	○	×										
Variolink II	200	○	×										
	400	×											
	800	×											

Table 11 *Removability of excess cement (using chemical polymerization)*

	AFTER PLACING THE RESTORATION /min.													
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	7.0	8.0
ESTECEM	×	○	○	○	○	○	○	○	×	×	×	×	×	×
BISTITE II	×	×	×	×	×	○	○	○	○	○	○	×	×	×
Clearfil Esthetic Cement EX	×	×	×	×	×	○	○	○	○	△	△	×	×	×
Panavia F2.0	×	×	○	○	○	○	○	○	×	×	×	×	×	×
RelyX Ultimate	×	×	△	○	○	○	○	○	○	△	×	×	×	×
Multilink Automix	×	△	○	○	○	○	○	△	×	×	×	×	×	×
Variolink II	×	×	×	×	×	△	△	△	△	△	△	△	○	×

4 Precautions for use

Precautions for Estecem are summarized below.

1. Use Estelink and/or Tokuyama Universl Primer as primers for the Estecem Paste. DO NOT use other primers or adhesives as primer for the adhesive surfaces.

   Reason: Adhesiveness was too low with other products.

2. Ensure equal amounts are being dispensed through the two outlets of the syringe prior to attaching a mixing tip.

   Reason: If equal amounts of Paste A and B are not dispensed, there is a possibility of poor polymerization.

3. DO NOT apply the Paste to the adherent surface treated with Estelink to avoid incorrect seating of the restoration (apply the mixed Paste to the surface of the restoration).

   Reason: Estelink will accelerate the setting of the Paste.

4. Light curing is needed for final paste hardening

   a) In case of translucent restoration materials such as ceramics or composite materials: Irradiate the light to the applied Paste on the seated restoration for 20 seconds or more. When the adherent area is too large to be completed by a single light-cure, multiple cures are recommended.

   - Confirm that the light-curing unit has sufficient intensity (>500mW/cm2) before using. Note that using a cracked light guide will lower the intensity.

b) In case of non-translucent restoration materials such as metal:
Light-cure along margins for 20 seconds or more, then allow the Paste to set for 8 minutes with the patient applying normal occlusal pressure to the restoration.

Reason: To ensure reliable bond strength (good clinical results).

5 Conclusion

Estecem is a resin cement having the following characteristics and is a useful material for dental practice.

The development concept of ESTECEM is as follows:

1. Easy and reliable adhesion
2. Superior esthetics
3. Ease of use (especially easy removal of excess cement)

6 References

1 *Kitayama S, Nikaido T, Takahashi R, Zhu L, Ikeda M, Foxton RM, Sadr A, Tagami J. - Effect of primer treatment on bonding of resin cements to ziruconia ceramic. - Dent Mater J. 2010 May;29(3):268-76*

2 *Al-Assaf K, Chakmakchi M, Palaghias G, Karanika-Kouma A, Eliades G. - Interfacial characteristics of adhesive luting resins and composites with dentine. - Dent Mater. 2007 Jul;23(7):829-39*

3 *Matsumura H, Atsuta M, Tanoue N. - Evaluation of two thione primers and composite luting agents used for bonding a silver-palladium-copper-gold alloy. - J Oral Rehabil. 2002 Sep; 29(9):842-6*

4 *Hirabayashi S, Yoshida E, Hayakawa T. - SEM analysis of microstructure of adhesive interface between resin cement and dentin treated with self-etching primer. - Dent Mater J. 2011 Jul 28;30(4):528-36*

5 *Kawamoto C, Fukuoka A, Sano H. - Bonding performance of the new Tokuyama Bond Force bonding system. - The Quintessence, Vol. 26 No. 3/2007-0614*

6 *Tagami J, Ito S, Ohkuma M, Nakajima M. - Performance and features of the new BOND FORCE adhesive resin. - The Nippon Dental Review, Vol. 67 (4)/Weekly No. 744, 163*

ESTECEM Packaging

ESTECEM

16140 **Estecem Kit Universal** (Paste 2,3+2,3ml - Estelink Bond A/B 1+1ml - Universal Primer A/B 1+1ml- Accessories)

Estecem Paste (Paste 2,3+2,3ml):

16150 Estecem Paste Universal
16160 Estecem Paste Clear
16170 Estecem Paste Brown
16180 Estecem Paste White Opaque

ESTELINK BOND

34540 **Estelink Bond Kit** (Bottle A/B 3+3ml)

Estelink Bond Refill (Bottle 3ml):

34550 Estelink Bond A
34560 Estelink Bond B

TOKUYAMA UNIVERSAL PRIMER

16550 **Universal Primer Kit** (Bottle A/B 2+2ml)

Universal Primer Refill (Bottle 2ml):

16560 Universal Primer A
16561 Universal Primer B

ESTECEM

Tokuyama Dental

X-rays check after 6 months.
Excellent radiopacity.

The new **Estecem System Kit**, ideal for a cementing effective: **Universal Primer** simplifies the steps of pre-treatment of the different materials for prosthetic structures (metals, resins, zirconia and ceramics), **Estecem** is the aesthetic resin cement dual-cure suitable for every clinical situation, **Estelink** its bonding agent dedicated.

Optimal seal, strength, durability and aesthetics high. Cementation more effective in all clinical situations with Estecem System Kit, the winning team of Tokuyama Dental

Indications:

Cementation of crowns, bridges, inlays, and onlays made of glass/oxide ceramics (porcelain, zirconia and alumina), metals/alloys (precious and non-precious) and resin materials including inorganic filler (composite materials)
- Repair of fractured porcelain fused to metal crowns and all ceramic restorations
- Cementation of veneers and adhesion bridges
- Cementation of metal or glass-fiber posts or quartz-fiber posts

ESTECEM SYSTEM CASE HISTORY Cementing of lithium disilicate crowns, courtesy of Dr. Gianluca Plotino - Rome (Italy)

1 Preoperative situation with two aesthetically incongruous crowns on teeth 11 and 21.

2 Intraoperative pictures of the abutments prepared and bleached.

3 The layered lithium disilicate crowns (dental technician Mr. Fabrizio Loreti) cemented with Estecem one week after cementing. The easy and effective removal of excess cement from the groove ensures a quick tissue healing.
4 Check after 6 months.

A very strong bond to the tooth by the action of Universal Primer on prosthetic structure.

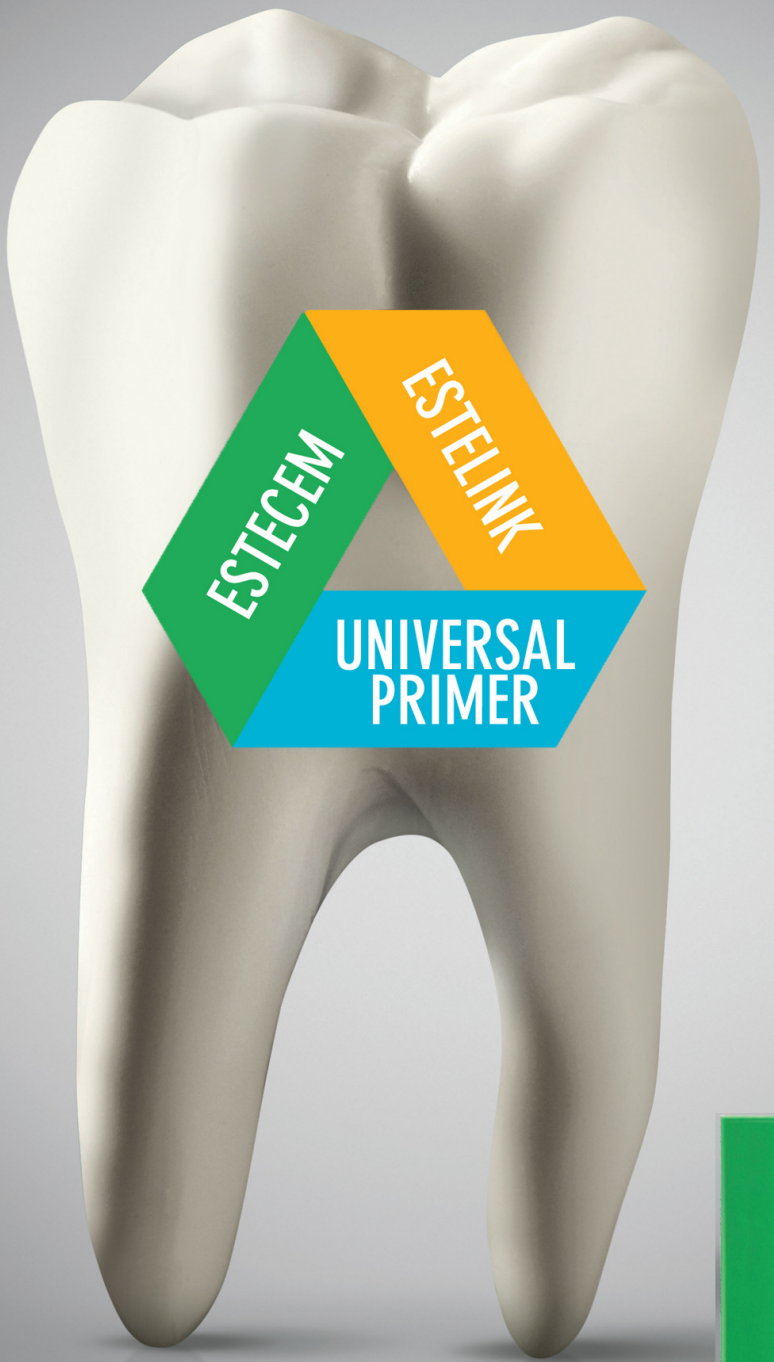
High mechanical strength and wear resistance in a thickness of thin films in µm.

Low absorption of fluids and low solubility.

Aesthetics and color stability in the long term.

Excellent workability and easy removal of excess.

Guarantee of an optimal seal in the interface between the structure and the tooth.



NEW

Tokuyama Dental

Optimal seal, strength, durability and aesthetics high.
Cementation more effective in all clinical situations with
Estecem System Kit, the winning team of Tokuyama Dental.

Tokuyama Dental Italy srl - Tel. 0445 334545 - Fax. 0445 339133
info@tokuyama.it - **www.tokuyama.it**