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Research Article

Cementation of IPS Empress II (e-max) with Tooth Dentine. EDX Analysis of the Cemented Interface

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Abstract

The influence of treatment of the surface of IPS Empress II (e-max) glass-ceramic with different silane agents protocols during the cementation of ceramic restorations with tooth dentine was evaluated considering the homogeneity of the cementation examining the interface values. IPS Empress II (e-max) cores pressed as veneers were treated with one silane agent, for the cementation with tooth dentine were used two different cements from the same manufacturer. After the cementation the IPS Empress II (e-max) veneers with tooth dentine were divided by using a dental high speed hand-piece under water spray. Our purpose was to observe the interface under Scanning Electron Microscope (SEM) and have Elemental Analysis of the cemented interface to investigate the chemical reaction among IPS Empress II (e-max), tooth dentine and cement.

Keywords: *Cementation; IPS Empress; Tooth Dentine; EDX Analysis*

Introduction

Nowadays is well known that we live at aesthetic evolution century of dentistry, 50 shades of white are provided from all-ceramic systems. These all-ceramic systems display outstanding characteristics according their chemical and mechanical composition and fine microstructure (Figure 1).

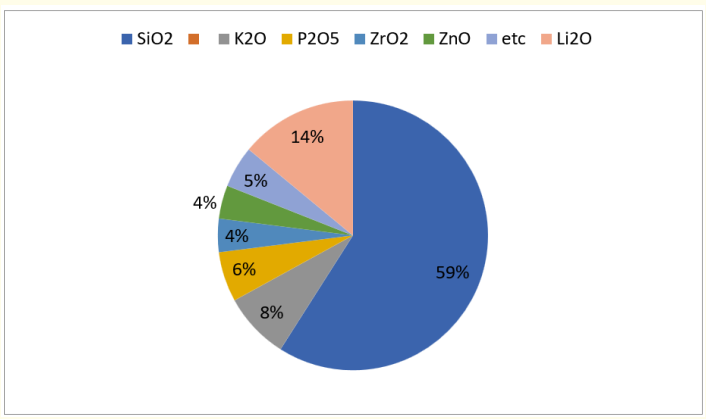


Figure 1: *Chemical properties of IPS Empress II (e-max).*

It is a fact from the literature that the surface treatment of both the ceramic part and the dentine matter of the tooth, influence and characterize the quality of cementation [1]. Specifically we remind etching with hydrofluoric acid aqueous solution (HF 10%) markedly increases the bond strength for time less than one minute. Actually, HF acid etching method is more effective than sand-blast and lazer [2,3]. Besides that, silane treatment increases the surface roughness which has great effect on the cementation [4,5]. However, dentists should precisely and carefully choose among silane agents those with clear step by step procedure.

IPS Empress II (e-max) glass-ceramic dental material treated with one silane before cementation with tooth dentine it's been shown how affects the surface with EDX Elements Analysis (Figure 2 and Figure 3) involving at the homogeneity of the bond without interfering at the bond with chemical substances. The whole chemical reaction is considered to be achieved by the elements of IPS Empress II (e-max) and the cement which chemical stability creates the bond with dentine. The evaluation of the cemented interface by the elements that exists after cementation revel's the complication of the achievement about cement IPS Empress II (e-max) with tooth dentine.

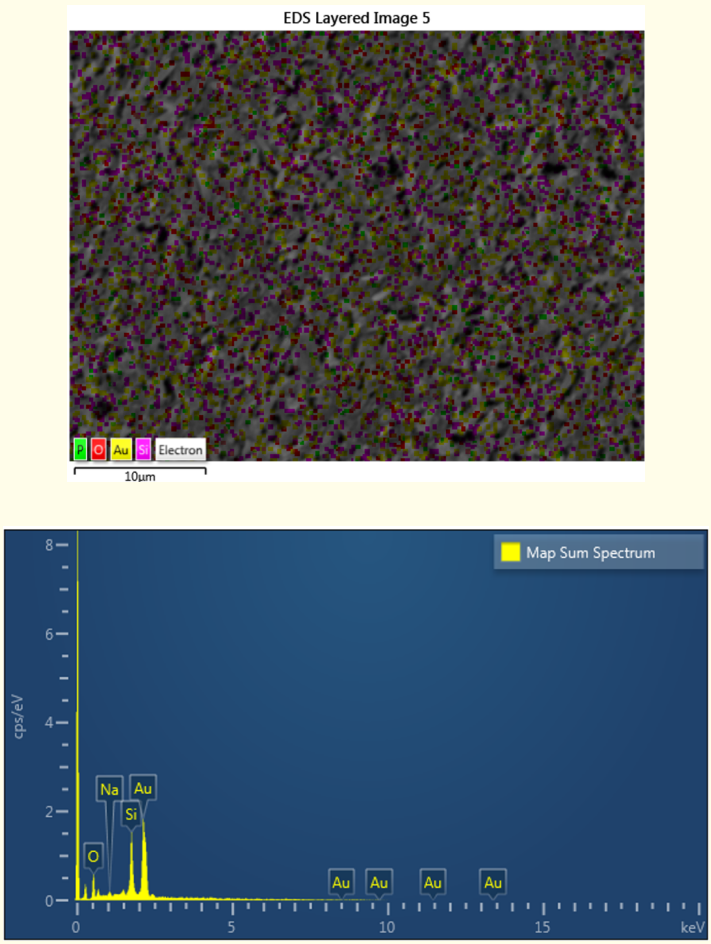


Figure 2: *Elemental Analysis of IPS Empress II (e-max) after etching for 30s with HF acid and silane treatment for 20s with Ceramic Primer Plus.*

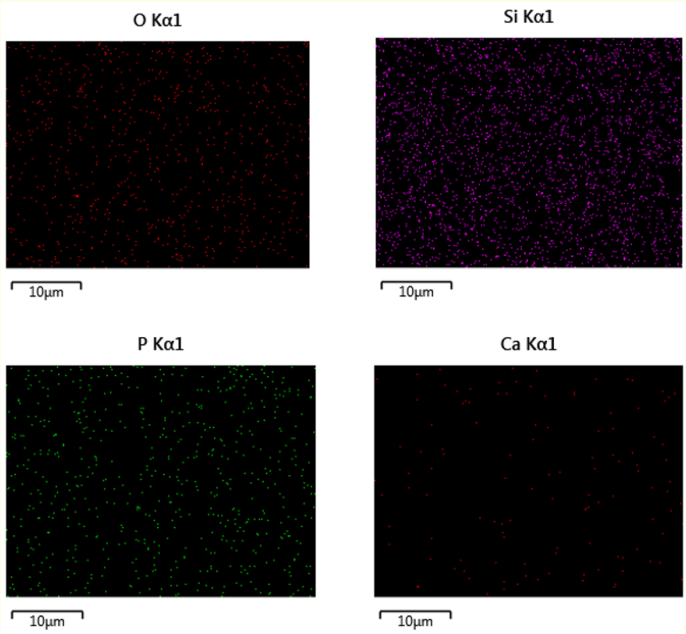


Figure 3: *Elemental Analysis of IPS Empress II (e-max) after etching for 30s with HF acid and silane treatment for 20s with Ceramic Primer Plus.*

Materials and experimental procedure

Natural, fresh extracted, third molars were prepared for IPS Empress II (e-max) veneers. Cores of IPS Empress II (e-max) were pressed and ceramic veneers were constructed for that cause. For acid etching, HF aqueous solution 10% was used for the ceramic surfaces for 30s and H3(PO4)2 aqueous solution 35% for the teeth for 15s, then washed for 10 s both sides with distilled water and finally air dried.

As far as the silane treatment of our veneers the silane agent below was used; Ceramic Primer Plus (by Kuraray, Tokio). For the cementation the resin cements that we used, are; Panavia F 2.0 (by Kuraray, Tokio), Panavia V5 (by Kuraray, Tokio) with the additional dentine primer named ED Primer II for Panavia F 2.0 and Tooth Primer for Panavia V5 that the manufactures propose for this cause.

Four (4) IPS Empress II (e-max) veneers were pressed. After the etching, the etched surfaces of the glass-ceramic samples were subjected to silane treatment (4 samples). For the silane agent two protocols were followed (1) Silane treatment for 20s and then being air dried and (2) Silane treatment for 24hours and then being air dried.

The veneers were permanently cemented and light- cured with dental LED lamb (900 - 1100 W) for 40s each one separately. The restored teeth were divided into two pieces so it could be able to observe the cemented interface under a scanning electron microscope (SEM) for EDX Elemental Analysis.

The interface samples that we created for scanning electron microscope (SEM) following silane treatment and cementation protocols as mentioned below;

1. Silane treatment with Ceramic Primer Plus for 20s on IPS Empress II (e-max) with ED Primer II for tooth dentine and cementation Panavia F 2.0 (Figure 4 and Figure 5).

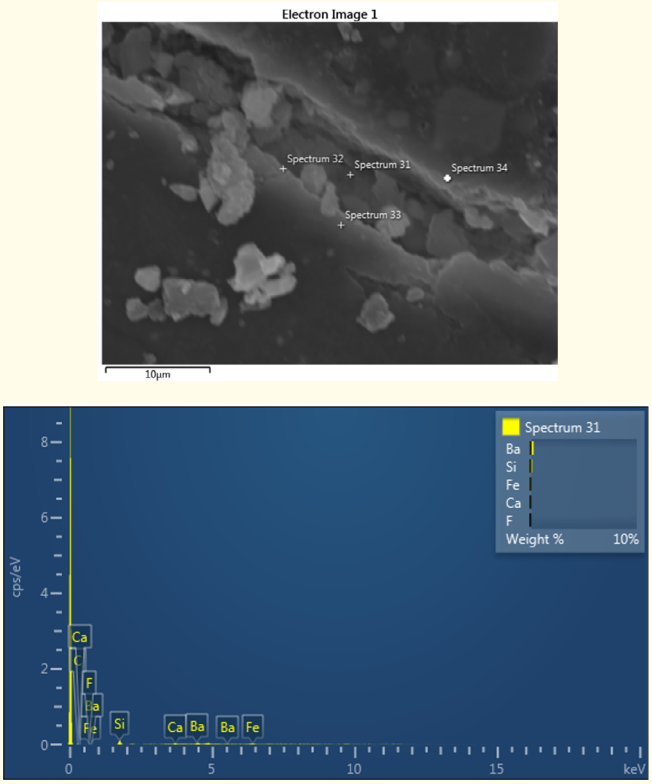
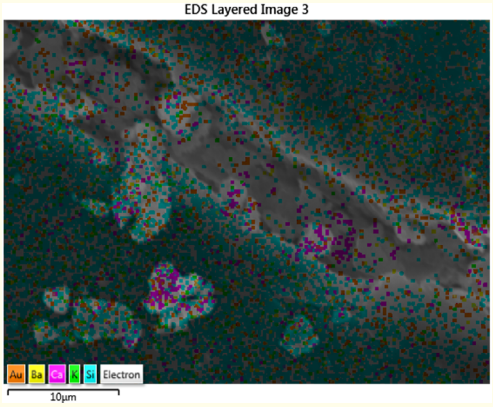


Figure 4: *Silane treatment with Ceramic Primer Plus for 20s on IPS Empress II (e-max) with ED Primer II for tooth dentine and cementation Panavia F 2.0 (Spectrum Point Elements Analysis).*



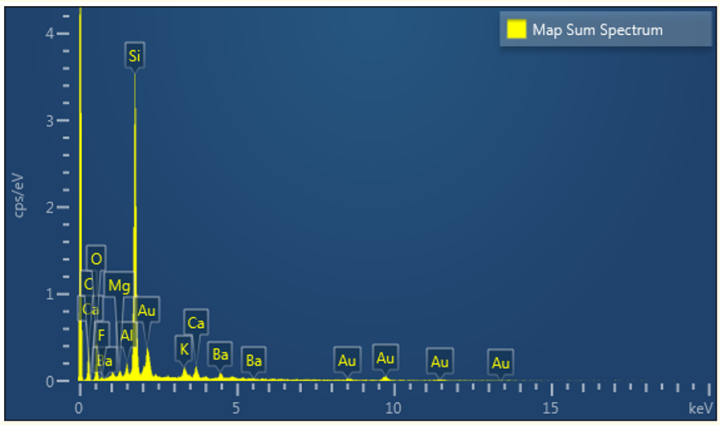


Figure 5: *Silane treatment with Ceramic Primer Plus for 20s on IPS Empress II (e-max) with ED Primer II for tooth dentine and cementation Panavia F 2.0 (Elements Mapping).*

2. Silane treatment with Ceramic Primer Plus for 20s on IPS Empress II (e-max) with Tooth Primer for tooth dentine and cementation with Panavia V5 (Figure 6 and Figure 7)

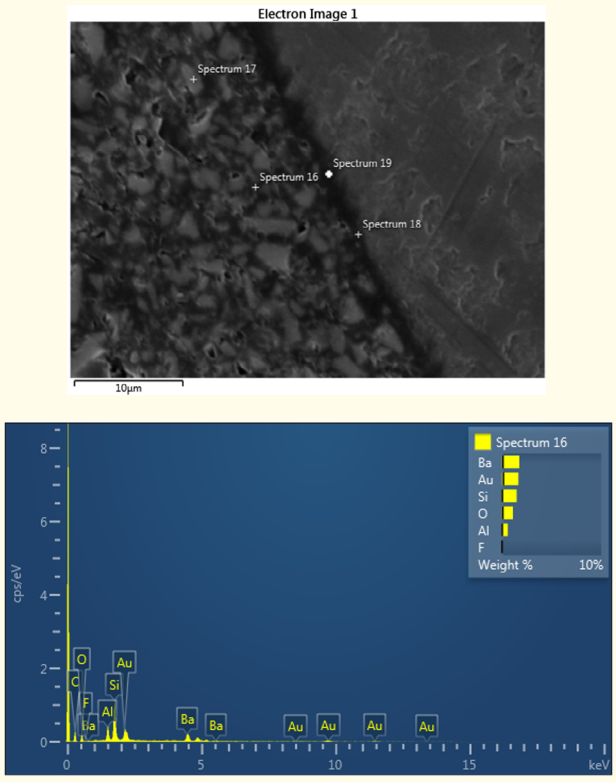


Figure 6: *Silane treatment with Ceramic Primer Plus for 20s on IPS Empress II (e-max) with Tooth Primer for tooth dentine and cementation with Panavia V5 (Spectrum Point Elements Analysis).*

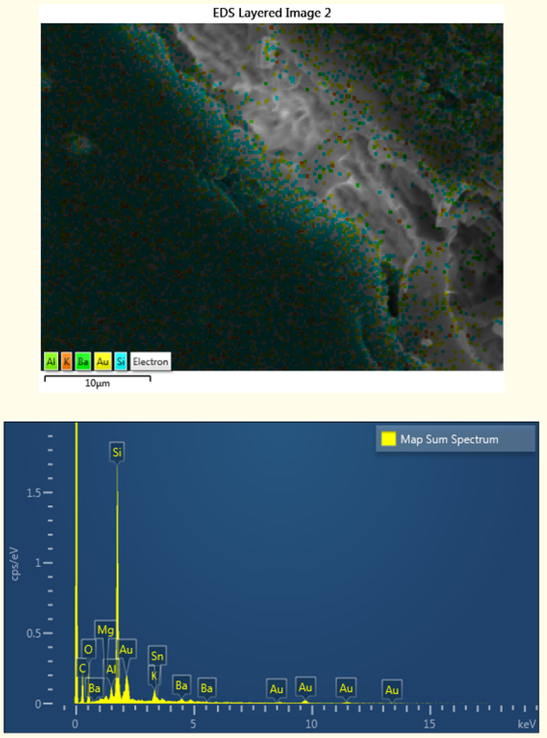


Figure 7: *Silane treatment with Ceramic Primer Plus for 20s on IPS Empress II (e-max) with Tooth Primer for tooth dentine and cementation with Panavia V5 (Elements Mapping).*

3. Silane treatment with Ceramic Primer Plus for 24 hours on Empress II (e-max) with ED Primer II for tooth dentine and cementation with Panavia F 2.0 (Figure 8 and Figure 9)

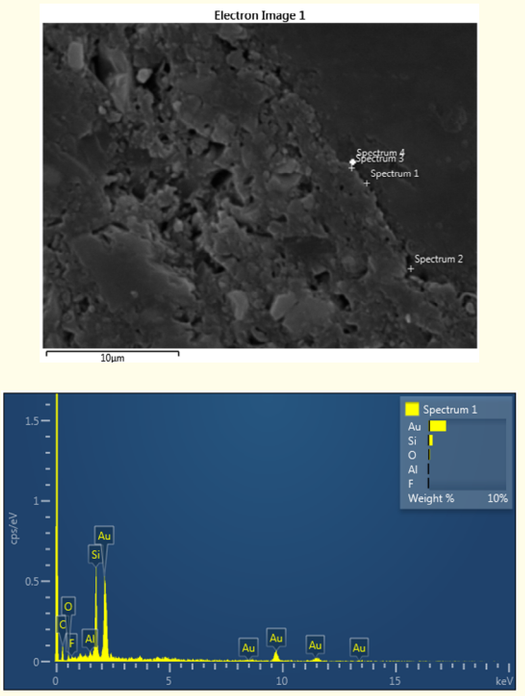


Figure 8: *Silane treatment with Ceramic Primer Plus for 24 hours on Empress II (e-max) with ED Primer II for tooth dentine and cementation with Panavia F 2.0 (Spectrum Point Elements Analysis).*

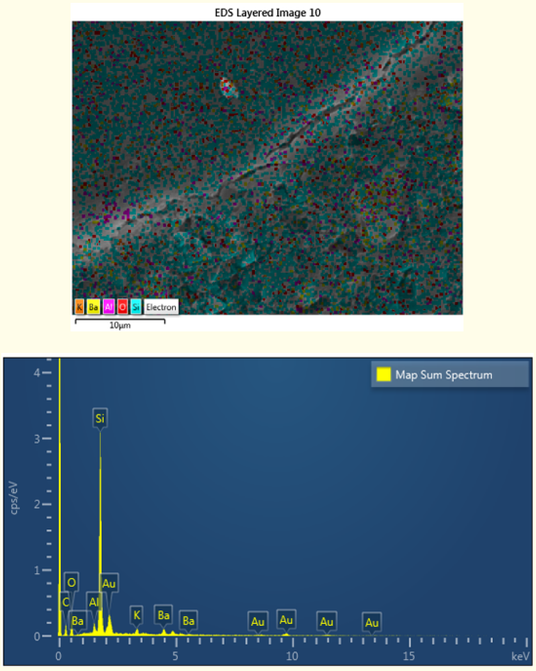


Figure 9: *Silane treatment with Ceramic Primer Plus for 24 hours on Empress II (e-max) with ED Primer II for tooth dentine and cementation with Panavia F 2.0 (Elements Mapping).*

4. Silane treatment with Ceramic Primer Plus for 24 hours on IPS Empress II (e-max) with Tooth Primer for tooth dentine and cementation with Panavia V5 (Figure 10 and Figure 11)

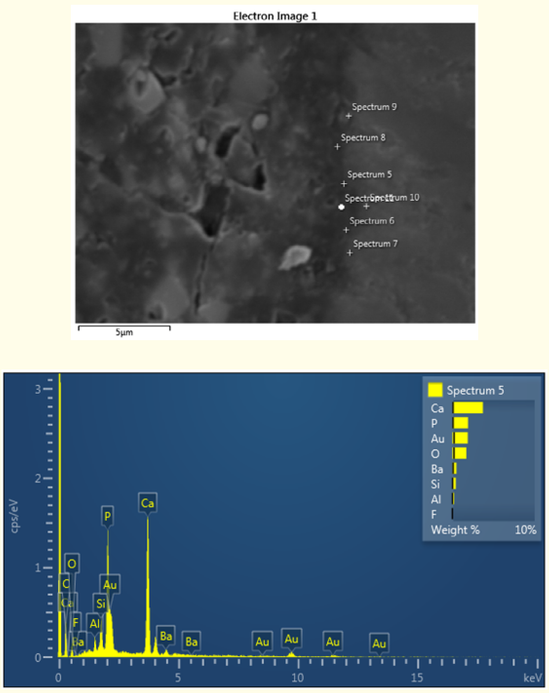


Figure 10: *Silane treatment with Ceramic Primer Plus for 24 hours on IPS Empress II (e-max) with Tooth Primer for tooth dentine and cementation with Panavia V5 (Spectrum Point Elements Analysis).*

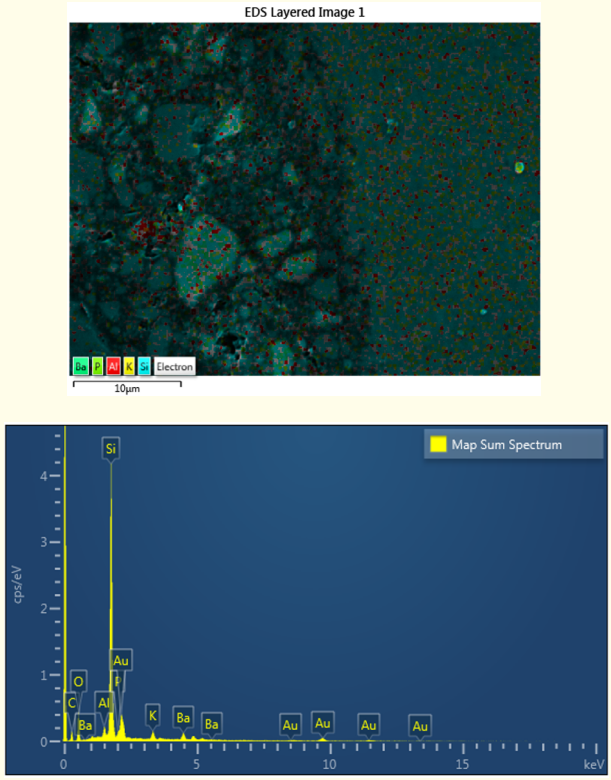


Figure 11: *Silane treatment with Ceramic Primer Plus for 24 hours on IPS Empress II (e-max) with Tooth Primer for tooth dentine and cementation with Panavia V5 (Elements Mapping).*

After the observation with scanning electron microscope (SEM), pictures were taken for the spectrum and the elemental mapping of the cemented surfaces following the above protocols to revel's the chemical properties of the cementation.

Results and Discussion

After scanning with electron microscope (SEM) the cemented interfaces of IPS Empress II (e-max) with toot dentine it's been revealed that the elements react after the cementation process.

According to manufactures the appearance of Si, O, K, P, are already there as components of IPS Empress II (e-max) (Figure 1). After the salinization process the only new element is Na, on IPS Empress II (e-max) surface (Figure 2) which after the cementation disappears. The existence of gold Au, is dew to the the gold-treatment of the specimens before examining them to scanning electron microscope.

At the interface observation according to the largest appearance, according to EDX Element Analysis, we find Al, Ba, C, Ca, Mg, Sn, F, Fe. Since all the samples have been scanned at the same time, all the elements we found are components of the cement. As a conclusion we are sure now that the stability of the bond it's dew to the chemical reaction of the cement with IPS Empress II (e-max) and tooth dentine. Disputes the silane is a chemical complex ceramic primer, no elements appear on the silaned surface of IPS Empress II (e-max) that still exists after the cementation process, so the silane doesn't interfere at the chemical reaction of the cementation. By treating dentine with ED Primer II and Tooth Primer, actually dentine primers, we reveal the collagen fibers thru the inorganic crystal dentine cells, creating the

organic phase of the dentine, which explains the existence of C, during the EDX Element Analysis. It's well known that the collagen fibers actually reacts with the cement on the dentine surface. The inorganic part of the dentine matter of the tooth, well-known as the crystal dentine- tubes micro-structure of dentine, doesn't react chemically, nevertheless it provides micromechanical stability to the cemented surface of the tooth. From the other hand, treating IPS Empress II (e-max) with HF acid and silane agent, we provide an increase of microstructure properties of the material, well known as ceramic roughness of the surface [8]. This fact actually creates micromechanical stability to the cemented surface of IPS Empress II (e-max). This chemical reaction actually creates the bond between IPS Empress II (e-max) and tooth dentine.

Conclusions

As it is concerned in a dental-practice, the quality of the cementation process of our ceramic restorations and tooth dentine is the main factor for a strong and long-term stability of them [6,7]. The results from the observation of the cemented samples of IPS Empress II (e-max) and tooth dentine under Scanning Electron Microscope (SEM) and an EDX Elements Analysis of the bond, leads to the conclusion that the cementation process is a very accurate procedure and the clinician providing that to a patient must be very precise to the cementation protocol to avoid any kind of mistakes that may lead to a potential failure of the bond and the restoration. We must be accurate every single time to every single restoration we provide to our patients, just to insure that everything will perform the best way all the times. That's the most secure and stable way to cement IPS Empress II (e-max) with tooth dentine.

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