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Electroforming Hybrid System (EIS®)

A combined procedure for ceramometal restorations.

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FIGURE 1 *Electroforming equipment*

Abstract

A new method has been developed to combine the high level of marginal precision of galvanoforming with the strength of the casting metal. The process is named the Electroforming HybrId System (EIS®). The tooth preparation, impression, and master model preparation are just as accurate in this process.

In the first step, pure gold cervical rings were prepared for all abutment teeth using the electroforming process. The margins of recovered gold rings were finished with a silicone wheel on both sides, cervical and coronal once and fitted on the dies. After insulation, the wax pattern with pontics was built—bearing in mind resistance, retention and aesthetic factors. The gold rings were removed from the wax pattern before the investing procedure. After casting, the investment material was removed using a sandblaster. The metal framework was fitted on the gold rings seated on the master model. The inner part of the cast copings and the external coronal part of the gold rings were sandblasted, covered with gold colloidal paste, joined together and dried with hot air for 10 minutes. The combined cast framework and gold rings were removed from the master cast and fired in a porcelain furnace at 980˚C for two minutes under vacuum. The ceramic baking procedure proceeds as usual.

In conclusion, with EIS® long span framework offers time savings with no need for pontic or connector solder joints. It is possible to improve marginal precision thanks to the superior malleability of pure gold.

Introduction

The clinical and technical advantages of the electroforming technique are well documented[1-11] with a marginal adaptation of 15-20 microns after ceramic baking have been reported[4,10]. Because of the high biocompatibility associated to the reduction of framework thickness (0.2mm) and the warm color of pure gold, which allows the highest aesthetic quality of auro-galva crown (AGC) restorations[7,8], the electroforming technique represents an alternative to porcelain fused to metal (PFM) restorations for all dentists, ceramists and patients.

The electroforming technique was originally indicated for single tooth restorations[1,2,4] because the mechanical strength of pure gold decreases significantly following the recrystallization process after ceramic baking[11].

For the construction of long span framework, many techniques have been introduced, but the complexity and high cost of certain techniques has limited their adoption in practice[11].

The Electroforming hybrId System, EIS®, (patent number AP98U000002) was introduced first by Tonino Traini in 1998. The technique was developed for combining the high marginal precision

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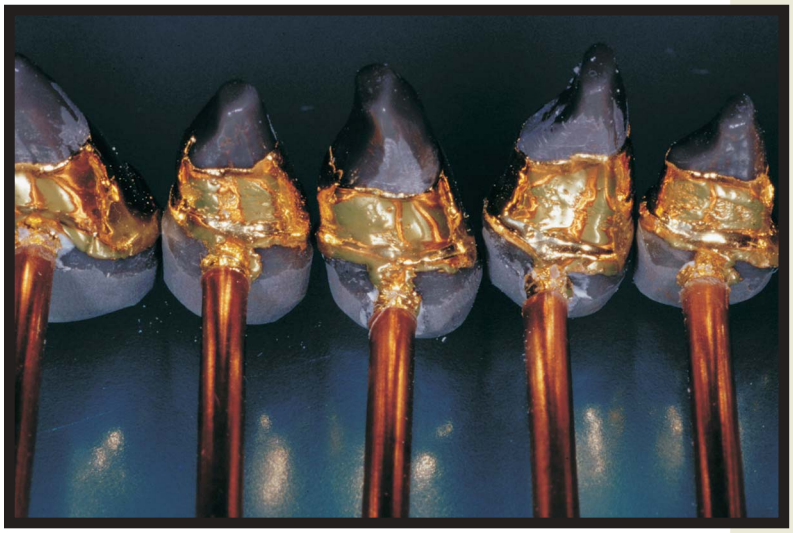
▼ **FIGURE 2** *Gold ring after electrodeposition.*



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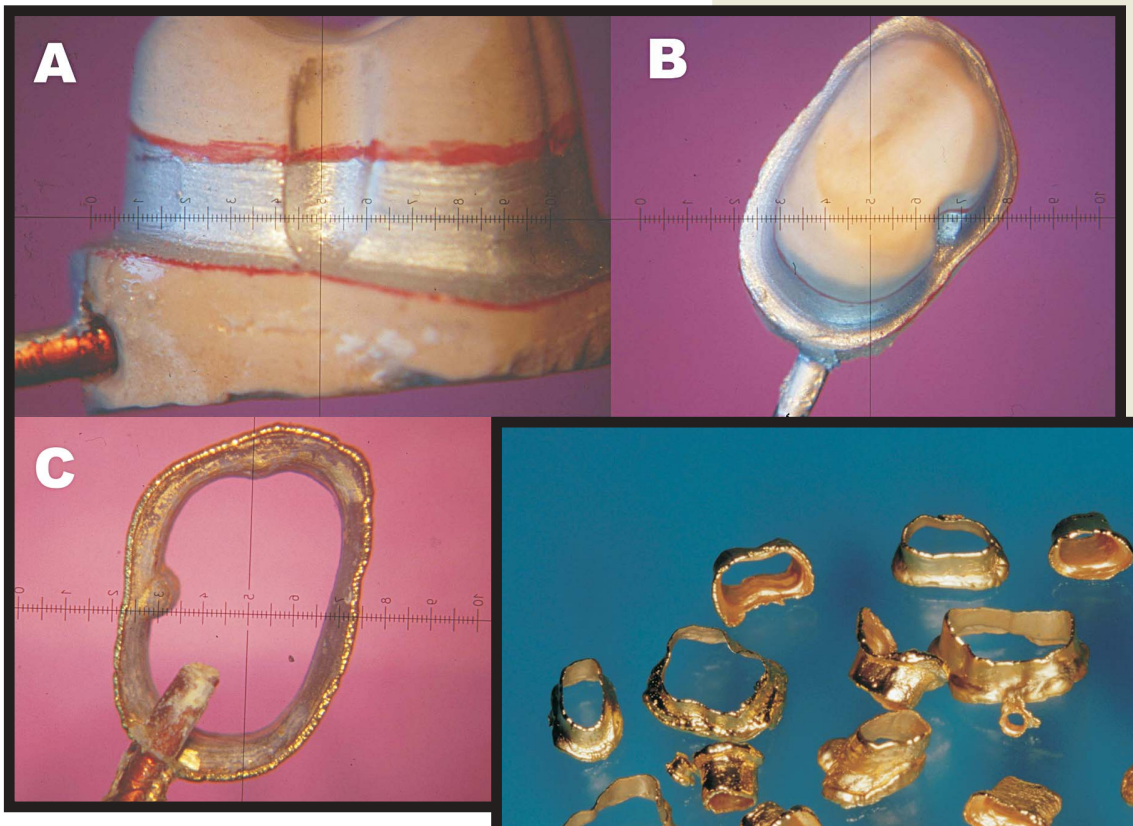
of electroforming gold to the mechanical strength of the casting metal[11]. The aim of this article is to introduce a step-by-step technical procedure of the EIS® system.

Materials and Methods

The tooth preparation and the impression should be accurate, as usual in fixed prosthodontics. The master model should be made using the Zeiser method.[12,13]

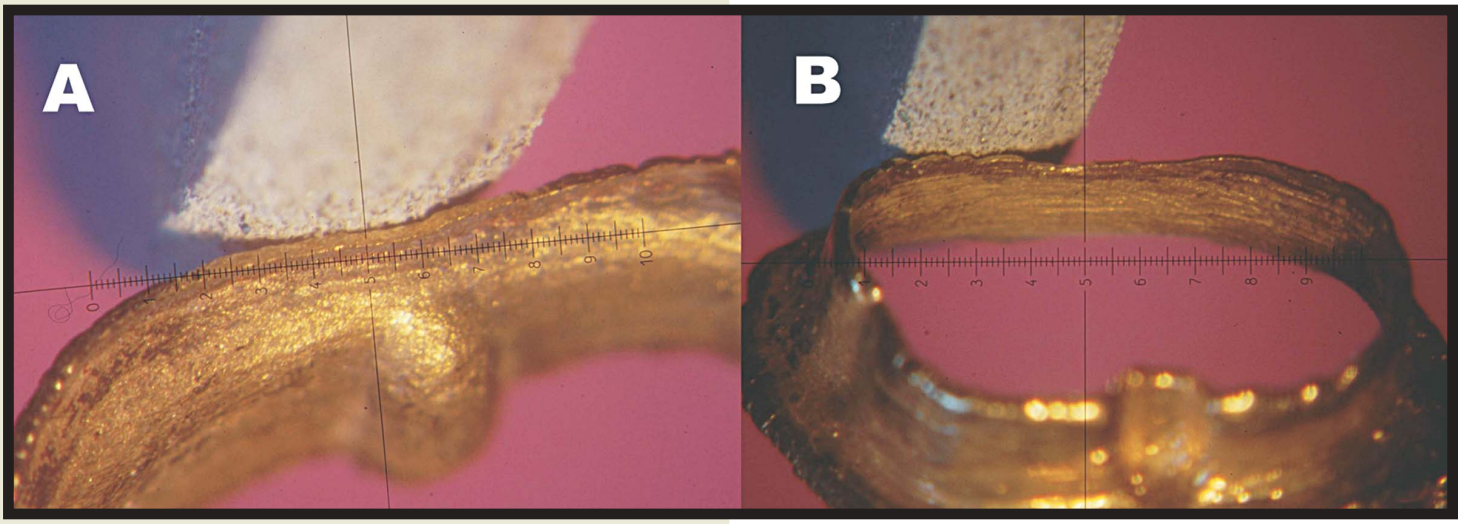
The first step is the fabrication of a pure gold cervical ring for all abutment teeth using the electroforming process (**Figures 1** and **2**). In order to do this, both a duplicated die from a master model or a secondary gypsum die poured into the impression may be used. The gypsum used for the die must be of type IV and it should have a low setting expansion (0,08 %). Before galvanization, a conductive silver powder is applied in the area where electro-deposition is needed and the contact pole is adjusted (**Figure 3**). In 240-300 minutes a 150mm gold layer is automatically created (**Figure**

▼ **FIGURE 3** *A, B: Gypsum die with silver layer. C: Gold ring with electrical contact.*

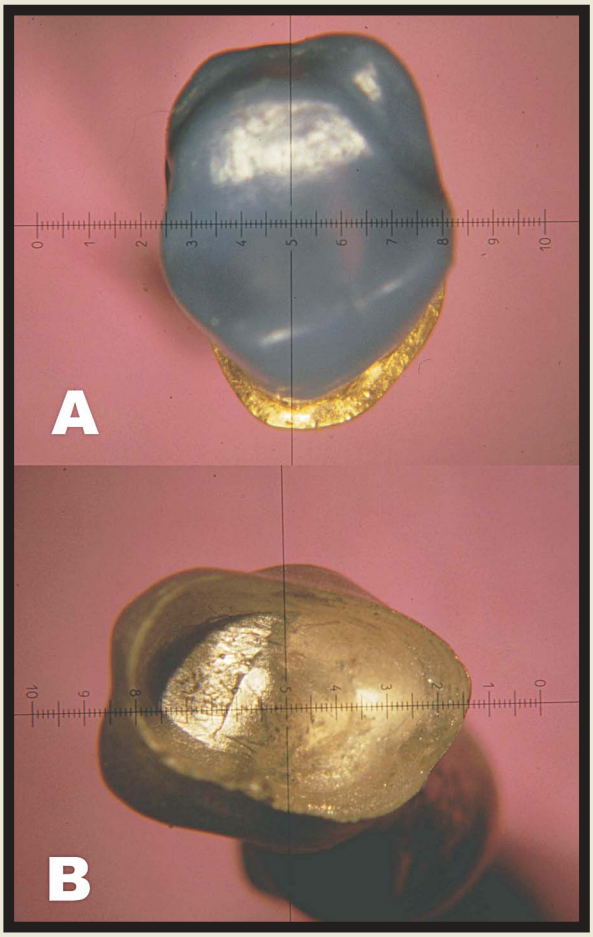


▲ **FIGURE 4** *Gold rings after removing gypsum.*

▼ **FIGURE 5** *A: Cervical margin finishing. B: Coronal margin finishing.*



▼ **FIGURE 6** *A: Gold ring with wax coping. B: Wax coping after casting.*



▲ **FIGURE 7** *Wax framework shape control on master model with gold rings seated.*

4). The thickness assures a fair strength and optimum space for aesthetic material at the margin level. After gold deposition, the rings are recovered by dissolving gypsum in an ultrasonic bath, while the silver layer was eliminated by pickling in a 10% nitric acid solution. The margins of the recovered gold rings are then finished with silicone wheels on the cervical and coronal sides (**Figure 5**). Cervical margins are finished as usual while coronal sides are reduced to a knife-edge thickness, then they are fitted on the master model's die.

The gold rings and dies are lubricated before waxing. The coping can be formed by dipping the die with the gold rings in molten wax while the pontic of the span is waxed as usual—bearing in mind strength, retention and aesthetic factors of the framework (**Figures 6** and **7**). The wax copings will incorporate the coronal margins of the cervical rings for about 0.5-1mm. The shape of the wax pattern is checked by using a silicone puddy index formed over the diagnostic wax-up. The gold rings are re

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moved from the wax pattern before investing and the casting procedure is performed as usual **(Figure 8**).

So there is no risk of margin damage, after the casting investment material is removed using a sandblaster (**Figure 9**). The metal framework is fitted onto the die of the master model with the gold rings and then soldered (**Figure 10**).

The soldering uses a paste of colloidal gold (Deck Gold Fine, Degussa, Frankfurt, Germany) because micro particles that form the gold paste sinter at a lower temperature than is required to melt pure gold (**Figure 11** and **12**). The inner part of the cast copings and external coronal wall of the gold rings are sandblasted with Al2O3 110 µ (Dental Farm, Torino, Italy) at 0,25 MPa, covered with gold paste, joined together and

FIGURE 8 *Metal framework after casting.*

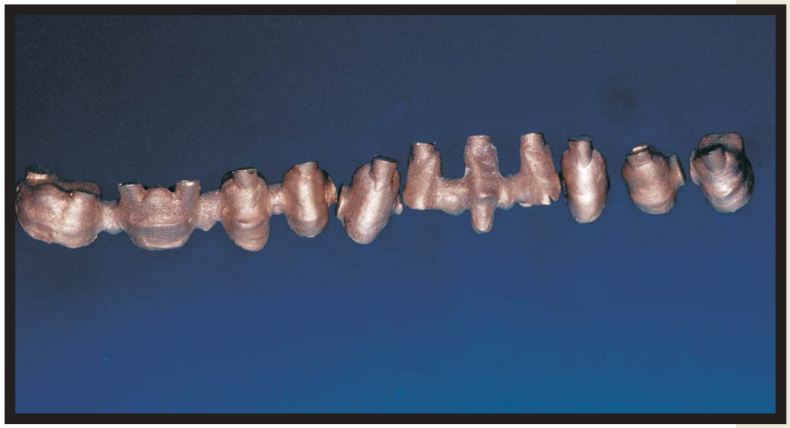

FIGURE 9 *Metal framework and electroformed gold rings.*

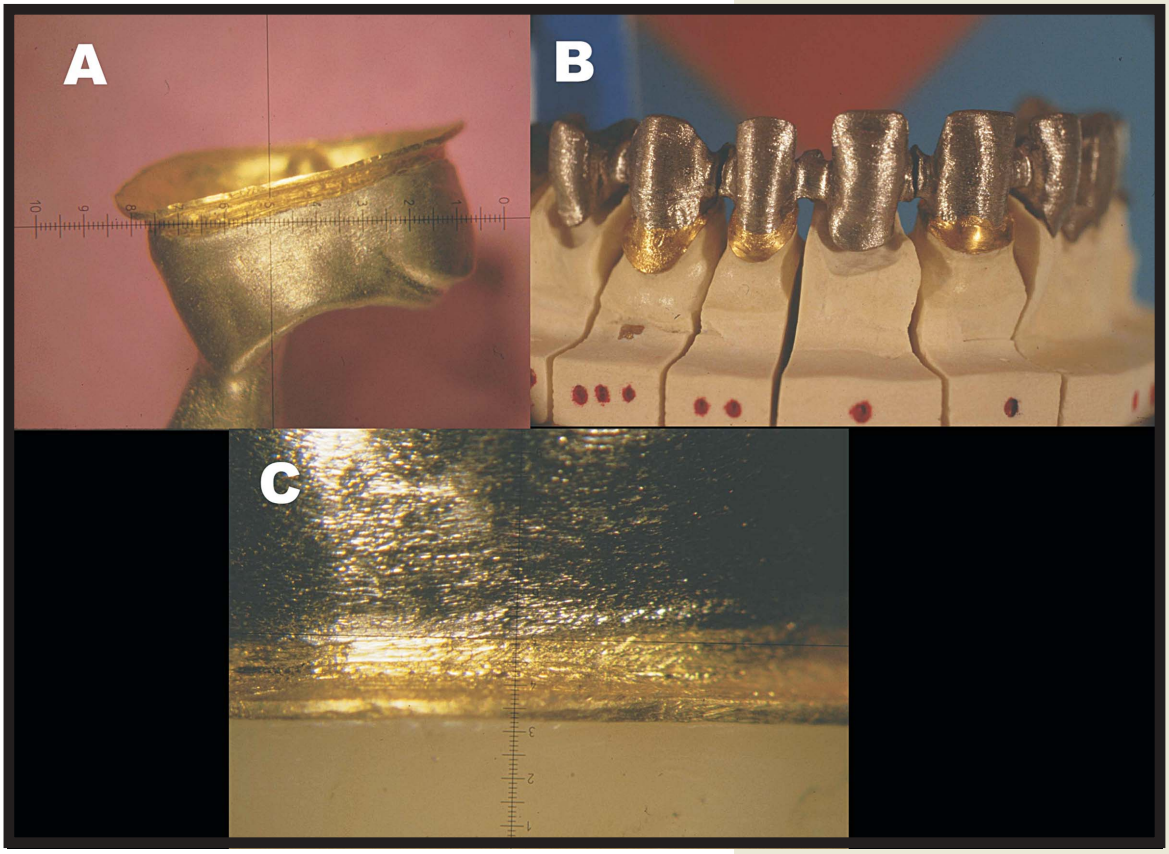

FIGURE 10 *Adaptation of casting on gold rings.*

dried with hot air for 10 minutes (**Figure 13**). At this time, the combined cast framework and gold rings can be removed from the master cast and fired in a porcelain furnace (Flagship VPF Jelenko, NY, New York) at 400˚C for 10 minutes to complete drying of colloidal gold. Sintering takes place at 980˚ C in 2 minutes under vacuum (–73 CmHg).

After soldering, the marginal fitting is verified intraoral where accessible margins are burnished with a smooth dull instrument (**Figure 14**, *see page 26*).

The surfaces that are to receive porcelain must be properly finished (**Figure 15**, *see page 26*), sandblasted and covered with a colloidal gold paste with ceramic particles to assure a strong bond with the ceramic. Bonder baking occurs during the oxidization cycle at 980˚ for 5 minutes. At margin level the gold ring does not oxidize, so the bond with the ceramic material is assured only by ceramic particles of the

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FIGURE 11 *SEM image at 29.120X of gold paste used for soldering.*

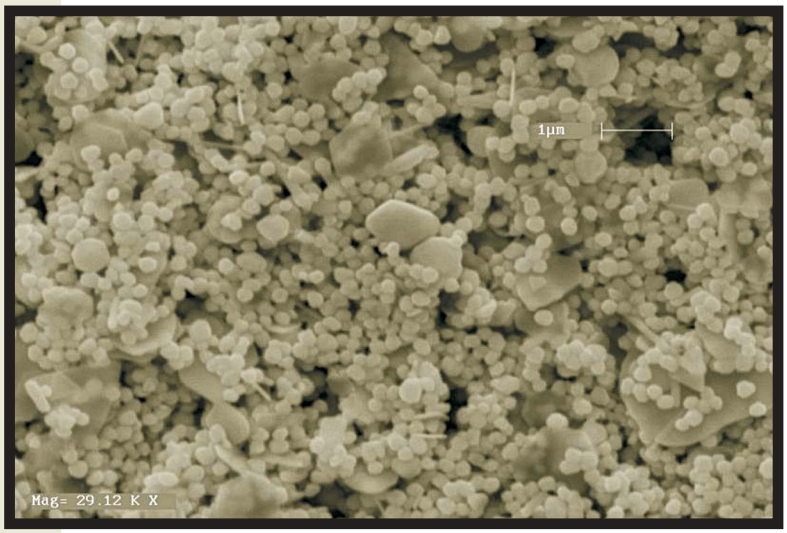


FIGURE 12 *Gold paste application.*

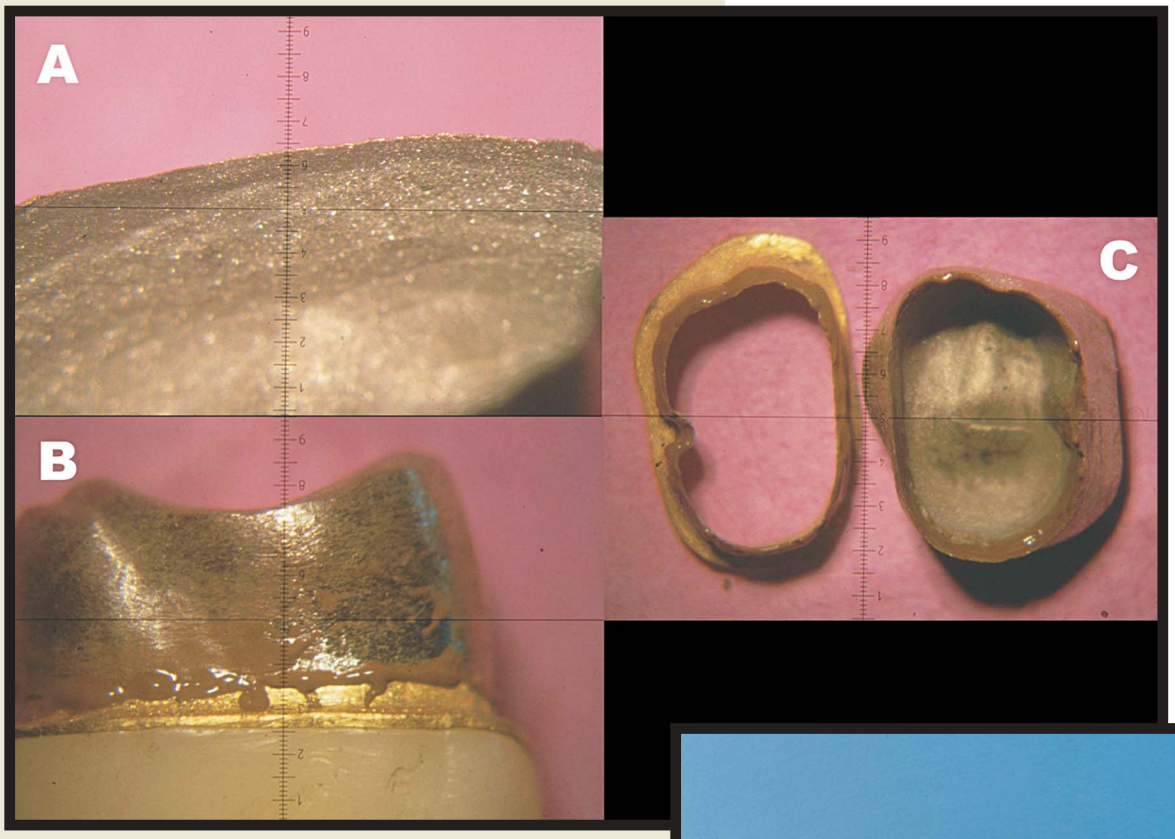
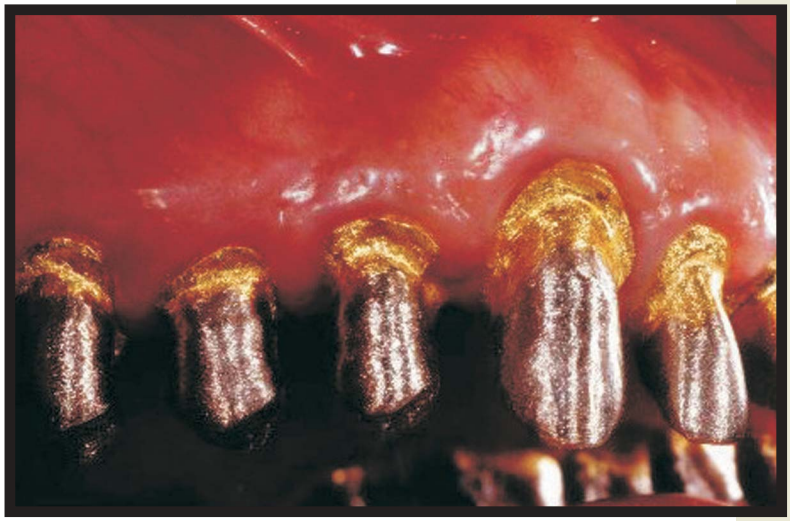
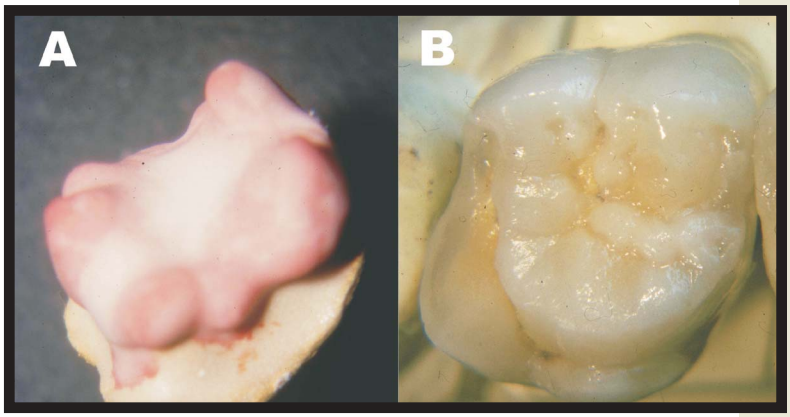


FIGURE 13 *Metal framework after soldering procedure.*

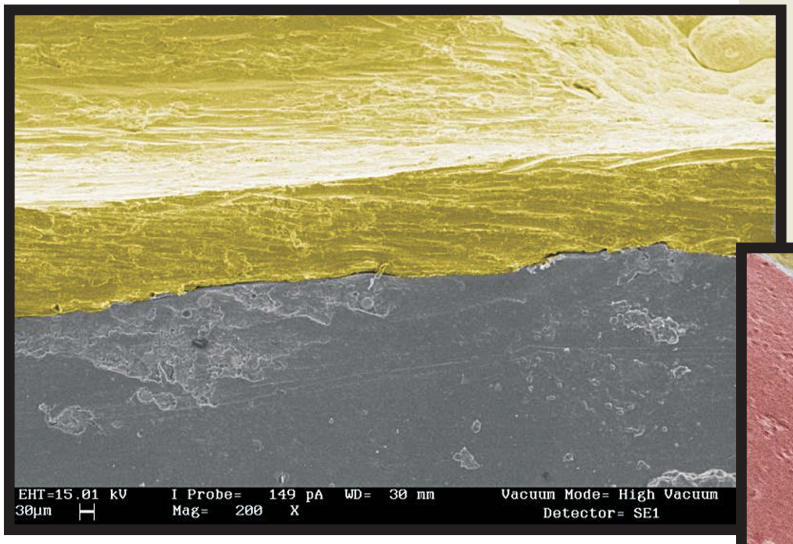
▼ **FIGURE 14** *EIS® framework in mouth.*



▼ **FIGURE 15** *Ceramic baking.*



▼ **FIGURE 16** *SEM image at 200X of the EIS® margin on master model.*



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bonder, while the yellow color facilitates a proper shade. The EIS® system allows for a good marginal fit even in long span frameworks, without solder joints, with a remarkable saving of time (**Figure 16**). A more interesting aspect is that the EIS® system allows monobloc casting without compromising the high marginal adaptation of AGC. Furthermore, it is possible to improve in mouth marginal precision—thanks to the high malleability of pure gold (**Figure 17**).

Conclusions

The laboratory time savings and highly standardized precision are the most important advantages. Compared with traditional procedures, the process of using the EIS® system for long span framework is less complicated than standard procedures, especially considering the high marginal adaptation normally obtained. **jdt**

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Donato Di Iorio is a dentist in private practice in Foggia, Italy. He earned his CDT at IPSIA San Benendetto Del Tronto in 1998 and his DDS at the University of Ancona in 2000. Dr. Di Iorio completed post graduate work in Fixed Prosthodontics at "G d'Annunzio" University of Chieti in 2002. He is also a Research Fellow at the University's Department of Applied Sciences of Oral and Dental Diseases.

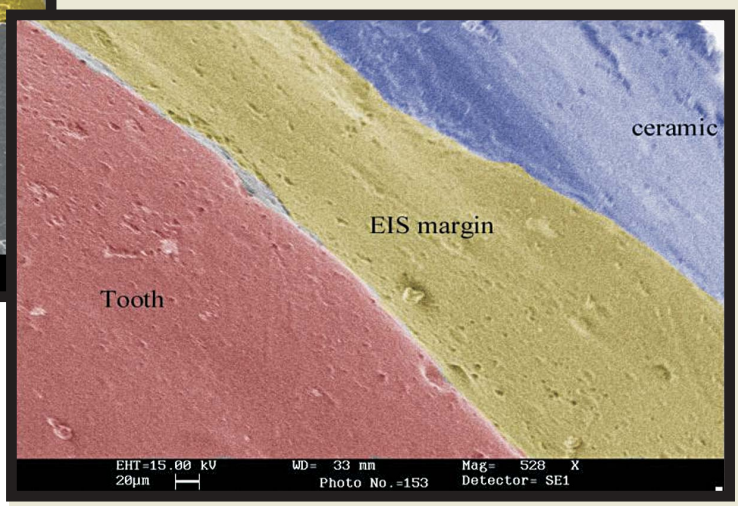

FIGURE 17 ▶ *SEM image at 528X of EIS® margin after cementing (replica technique).*

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CREDITS

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