CEREC inLab: Clinical Aspects, Machine and Materials

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This article presents a brief clinical case in combination with laboratory data to evaluate the inLab system and validate its use for a variety of clinical indications.

Introduction

Today’s restorative dentist has many materials and systems from which to choose. Decisions are based on a number of the following criteria:
– Evidence-based documentation
– Predictability
– Prognosis
– Biocompatibility
– Esthetics
– Ease of use

Each clinician may choose to add to this list or prioritize the degree of each criterion’s importance. Esthetics is usually at the top of the list with respect to patient demands. This requires the clinician to select the proper restorative system that addresses the patient’s esthetic requirements but also fulfills the functional demands of the case while ensuring long-term success. In order to maximize esthetics, we generally turn to ceramic restorations and, in particular, all-ceramic systems. Although many believe that all-ceramics cannot have long-term success equivalent to that of metal-ceramics, the Vita In-Ceram materials are clinically proven with success rates of 95%–98% after 7–10 years.\(^1\)\(^–\)\(^4\) These materials, in combination with the inLab CAD/CAM (computer-aided design/computer-aided manufacturing) system, allow for the fabrication of highly reliable, esthetic restorations for all areas of the mouth for a variety of clinical indications.

Although the use of CAD/CAM seems to be a recent addition to the dental restorative armamentarium, this concept was first investigated over 25 years ago by a number of individuals. Development of CAD/CAM systems for the dental profession began in the 1970’s with Francois Duret in France, Col. Bruce Altschuler in the United States, and Mörmann and Brandestini in Switzerland. Professor Mörmann’s work led to the development of the CEREC 1 CAD/CAM System (Sirona, Bensheim, Germany). CEREC was the first system introduced to the marketplace, and has over 15 years of use in the dental office. The CEREC concept consists of three parts:
– Esthetic CERamic REConstruction.
– Single patient visit.
– Minimal tooth reduction—inlays and onlays instead of crowns.

In the past 2–3 years, there has been an explosion in the development of CAD/CAM systems for dental laboratories. Most of these systems are generally large and cost as much as $400,000. Two systems, LAVA from 3M ESPE and CERCON from Dentsply/Degussa, are designed to fabricate dense zirconia frameworks by milling porous (50% dense) partially fired zirconia. The milled coping is then fired at high temperature for 6–8 hours to produce dense zirconia. Adequate compensation for shrinkage must be made in order to mill oversized structures that will have an acceptable, reproducible fit after firing.

Sirona has used much of the CEREC technology to develop inLab, a dental laboratory-based system designed to fabricate high-strength all-ceramic restorations (Fig. 1). A laser scanner is used to create a digital model of the master die, and PC-based Windows software is used to design crown and bridge frameworks that are milled from porous (80% dense) blocks of In-Ceram Alumina, Spinell and Zirconia (Fig. 2). The remaining pores are filled in a glass infusion step, which requires only about 20 minutes for single copings to 1.5
hours for large frameworks. There is no shrinkage after milling of the In-Ceram framework, so a reliable fit is assured. Highly translucent In-Ceram Spinell (350 MPa flexural strength) is primarily used for esthetic anterior crowns; In-Ceram Alumina (525 MPa flexural strength) for anterior crowns, bridges and posterior crowns; and In-Ceram Zirconia (750 MPa flexural strength) for use anywhere in the mouth, but especially for high-stress applications, posterior crowns and bridges. The inLab system itself is small and only occupies the space of an average desktop computer.

**CEREC inLab Clinical/Laboratory Process**

Tooth preparation is, as in any dental restoration, critical. For In-Ceram-based restorations, the occlusal reduction should be 1.5mm with axial reduction of 1.3 mm to produce an In-Ceram core of about 0.7mm to 0.5mm, and about 0.8mm of Vitadur Alpha veneer porcelain (Fig. 3). Margins should be either a butt joint or a modified chamfer preparation (Fig. 4).

A final impression is required, and the dental laboratory may use a conventional die material, which is then coated with a reflective powder, or a reflective stone may be used instead. This model is placed in the CEREC inLab unit for laser scanning (Fig. 5) to create a digital image for computer-aided design (CAD) (Fig. 6). After the design is complete, the appropriate type and size of In-Ceram block is inserted into the milling chamber and the framework is machined using diamond burs (Fig. 7).

The milled In-Ceram may be checked and easily adjusted on the model. Although the In-Ceram material is porous, it still has a strength of about 50–60 MPa, almost that of a fully dense porcelain. It is not extremely fragile or soft like other CAD/CAM zirconia materials and, unlike in other systems, it may be repaired if an error occurs during finishing using the Vita Optimizer material. The framework is then glass-infiltrated (Fig. 8) and the appropriate shades and opacities of Vitadur Alpha porcelains (Figs. 9 & 10) are applied to form the final contours of the restoration.

Rarely should there be issues with internal fit of the final restoration. If a discrepancy is found, it may be adjusted using diamonds with a water spray. Once the restoration’s interproximal contacts, marginal integrity and occlusion are confirmed, the internal aspect of the restoration may be micro-etched and steam-cleaned. Gluma may be applied to the preparations. The choice of cements will depend on the framework material. In cases where a high degree of translucency is not required and/or some opaquing is necessary (i.e., post and core), an easy-to-use cement such as 3M RelyX Luting Cement is appropriate. 3M RelyX Unicem in the appropriate shade should be considered whenever translucency is important, especially with the In-Ceram Spinell- and Alumina-based restorations.
An example of the highly esthetic results obtained using the CEREC inLab system in combination with In-Ceram is demonstrated in the following case. A patient requested that an existing porcelain-fused-to-metal crown be replaced due to poor esthetics. A discolored cervical resin restoration is also present (Fig. 11). The crown was removed and the tooth was re-prepared with a modified chamfer preparation. A milled In-Ceram Alumina restoration was fabricated to replace the crown, and is seen here immediately after delivery (Fig. 12).

**CEREC inLab Laboratory Study: Material Strength and Fit**

In selecting a CAD/CAM system, it is important to evaluate the machine as well as the properties of the materials. A successful system must have both reliable materials and equipment to produce esthetic and reliable restorations. Our study examined load to failure of inLab frameworks fabricated from In-Ceram Alumina and Zirconia. These were compared to frameworks fabricated from Empress 2 and Procera alumina. In-Ceram is an interpenetrating phase material that has a completely interconnected structure that may better resist crack propagation as compared to conventional materials. Empress 2 is a pressable glass ceramic with about 60-70% lithium disilicate crystals surrounded by a glass matrix, and Procera consists of a fully dense polycrystalline alumina. A three-unit bridge framework was designed and milled out of In-Ceram Alumina and Zirconia. A pattern with the same dimensions was fabricated and used to press Empress 2 frameworks and fabricate Procera copings. Procera bridges cannot be fabricated as a single unit; they must be constructed by soldering a prefabricated pontic to the custom copings. In the case of Procera, a pontic was selected and adjusted to dimensions equivalent to the milled and pressed pontics. The pontic was then soldered to the Procera abutments using the Procera joining materials—essentially, an In-Ceram Alumina slip and infusion glass.

The bridges were cemented to standard acrylic dies using a composite resin cement, 3M RelyX ARC. They were then loaded in the pontic region until failure. The load to failure for each is shown in Fig. 13. The margin gap of the milled In-Ceram Zirconia was lower than the pressed Empress or Procera. The values also had a lower standard deviation, indicating a more reproducible result. The margin gap of Procera was significantly higher, with a large spread in the data indicating a significantly lower reproducibility in fit, as has been demonstrated in other studies. Load to failure and margin gaps were significantly different between all groups tested using Multiple Anova and Tukey at the 0.05 level.

**Conclusion**

In any dental restoration, planning is key. Choice of materials plays a paramount role in the planning process. Vita In-Ceram materials as used in the CEREC In-Lab process maximize the predictability, biocompatibility, esthetics and, ultimately, the prognosis of our final restorations.

**References**

1. Hüls A. All-ceramic restoration with the In-Ceram system, International Conference, Georg-August University, Germany, 1996.

Clinical pictures courtesy of Dr. Stephen Tsotsos.