Review Article

CEREC - The power of technology

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CEREC is an acronym for chairside economical restoration of esthetic ceramics. Translated, it means that a dentist can economically restore damaged teeth in a single appointment using a high-quality ceramic material that matches the natural colour of other teeth. With over 7,000,000 restorations placed since the introduction of CEREC technology in 1987, CEREC is one of the most researched restorative systems in the market, with documented success rate of more than 90% after 10 years. It uses a sophisticated combination of high-tech precision machinery and computer technology to produce custom restorations that include 3/4 crowns, full crowns, veneers, inlays and onlays. The CEREC 3D system allows the dentist to take digital impression with 100% control of the margin fit, aesthetics, proximal contacts and the occlusal surface. With ongoing research and development, the CEREC system has earned its role in dental history as the technology that gives patients one of the finest restorations in the world in only one visit.

Key words: Chairside economical restoration of esthetic ceramics, crowns, marginal fit, metal free ceramic restorations

Technological advances have contributed immeasurably to efficient procedures, quality treatment and patient satisfaction. Chairside economical restoration of esthetic ceramics (CEREC), a computer-assisted design/computer-assisted manufacture (CAD/CAM) development that has been on the market for 15 years, is one such innovation. Capable of providing a durable, cosmetic, nonmetal restorations like crowns, veneers etc. in only one appointment and in less than an hour, the efficient use of the CEREC unit contributes markedly to quality care, patient satisfaction and practice profit.

WHAT IS CEREC?

CEREC is an acronym for chairside economical restoration of esthetic ceramics. CEREC system (Siemens/Pelton and Crane, Charlotte, NC)[1] was developed in 1985 by two Swiss researchers, a dentist and an electronics engineer, from the University of Zurich. CEREC is the newest innovation in ceramic cosmetic dentistry. It uses a sophisticated combination of high-technology, precision machinery and computer technology to produce custom restorations that include 3/4 crowns, full crowns, veneers, inlays and onlays.

What should one know about CEREC?

- CEREC is a proven technology, with more than a decade of clinical research and documentation.
- Aesthetics and convenience converge to offer an eye-pleasing and quickly obtained solution to damaged teeth in a single visit.
- Ceramic restorations are metal free, biocompatible, antiabrasive and plaque resistant.
- Using CEREC and advanced-bonding techniques, we are able to restore teeth to their original strength and function.
- More than seven million CEREC restorations have been performed worldwide.
- CEREC is ideal for crowns, veneers and fillings.

HOW CEREC WORKS?[2]

Digital impression

After examining the tooth and determining the course of treatment, we prepare the tooth for restoration, similarly to traditional treatment methods. The prepared tooth will be coated with a safe, tasteless powder. The CEREC acquisition unit is mobile and houses a computer and the CEREC camera. CEREC then uses a state-of-the-art digital 3D camera to create an optical impression. This digital image replaces the physical impression required in traditional procedures. So, no longer waits are required while a tray of impression material hardens in patient's mouth.

Computer aided design

The computer and CEREC 3D software converts the digital picture to a 3D virtual model of the prepared

tooth. The dentist then designs the restoration right on screen using the software while the patient waits. This software can assist the dentist with designing any tooth restoration like crowns, inlays, onlays and veneers. Once the dentist has designed the restoration (about 5 min), he or she clicks a button and the design data is communicated via a wireless radio signal to the CEREC milling unit.

Mill and place

Exact design specifications are sent to the on-site milling machine to create the restoration while the patient waits. The dentist selects a ceramic block that matches the shade of the tooth being repaired. He then inserts the block into the milling unit. The data from the acquisition unit is used to direct two diamond-coated burs to carve the block into the indicated shape of the restoration. This process usually takes 8-18 min depending on the size and type of restoration. After the milling is finished, the dentist polishes the finished filling or crown and bonds it into place.

CEREC 3D

The latest incarnation of the CEREC system is the CEREC 3D, which provides a versatile, relatively simple, user-friendly method for fabricating aesthetic restorations chair side without involving a dental laboratory.[3] Sirona's CEREC 3 was introduced in 2000. However, CEREC 2 continues to be sold and supported. CEREC 3D is a complete and unique system that allows dentists to mill solid ceramic producing perfectly fitting crowns and veneers in a single visit. The system is manufactured by Sirona (formerly Siemens Dental). The 3D software allows the dentist to take an optical impression with an infrared camera and go on to design perfectly fitting restorations. The dentist has 100% control of the margin fit, proximal contacts and the occlusal surface. Aesthetic considerations can be accommodated in the design. The advanced 'six axis' milling machine [Figure 1] produces the restoration within 10 min. This sophisticated machine works to within 50 micron. The ceramic can be stained and glazed. Characterization can also be done in the clinic.

So what's new?

- Milling chamber is separate from the imaging/designing unit.
- The system is now Windows based.
- CEREC 3 can be used in conjunction with a CEREC 2 by using the 'Link' software.
- Two burs (one is tapered) do the cutting instead of one bur and one diamond wheel.
- No 'adjust' process (time savings).
- Faster milling times (5 min savings).
- Greater occlusal anatomy.
- All design windows can be open at once.

The new CEREC 3 software is Windows based allowing greater compatibility and sharing possibilities.[4]

CEREC crowns

To understand the CEREC crown, we need a little background in the construction of a crown.

How crowns are made?

Usually a crown takes two visits: on the first visit, the tooth is prepared and an impression is taken. This impression is sent to a laboratory, where the crown will be made. Meanwhile, the patient wears a temporary crown made with some type of plastic material. On the second appointment, the temporary crown is removed and the durable crown is placed on the prepared tooth.

CEREC one-visit crowns

A recent innovation available in the offices of some cosmetic dentists is the 'CAD-CAM' crown. This crown is milled by a computer to fit the tooth precisely, thus eliminating the laboratory step in manufacturing the crown.

Advantages of CEREC

1. CEREC crowns are made in one visit, saving both the dentist and the patient time.
2. With CEREC, there is no need for a temporary crown, which eliminates one of the potential discomforts for the patient.
3. CEREC crowns have no metal in them and thus are aesthetic. Although the PFM can mimic natural tooth appearance, the metal limits translucency and can sometimes show through as a dark line, especially at the gum line.
4. CEREC material and technology can also be used for fillings. Since they are made out of porcelain**,** they are more durable than typical white composite fillings.
5. The thermal expansion of the CEREC material is similar to that of teeth which means eating hot and cold food will not cause differential expansion/contraction of the restored tooth**,** as in the case of metallic restorations.

Disadvantages of CEREC

1. Since CEREC crowns are milled out of a single block of ceramic, it is difficult to incorporate into them the subtle colour gradients of natural teeth. There are a very few cosmetic dentists that are using external stains to create natural-looking dentistry for the front teeth**,** but doing this is painstaking and difficult. Conventional porcelain crowns are made with a variety of colours in order to look natural.

Figure 1: The six-axis milling machine

Figure 2: Die is inserted into the scanning-milling chamber

Figure 3: Milling block selected and inserted into the block holder

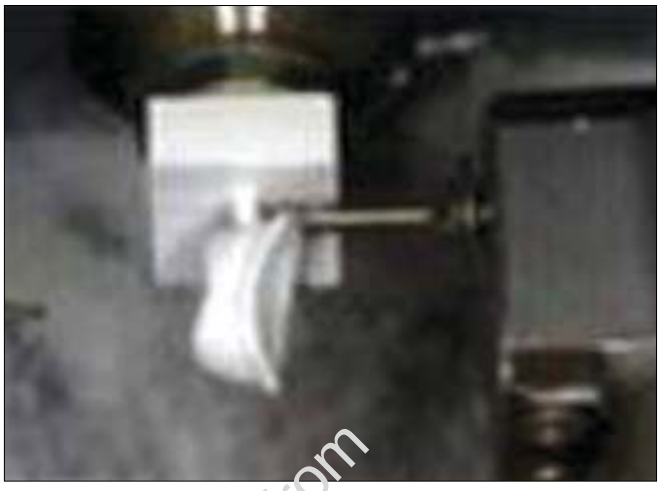

Figure 4: The milling of the coping is completed

Figure 5: Milled coping placed on the master die to verify fitr

Figure 6: Margins are finished to final thickness with rubber wheels

2. CEREC technology is expensive
   CEREC used as InLab copings

CEREC InLab copings provide strong and aesthetic results through their clinically proven CEREC and VITA In-Ceram technologies. Crown and bridge copings are milled out of a single solid block of VITA In-Ceram material. Precise software design is able to accurately set margins, coping thickness and porcelain support.

The advantage of CEREC

X-rays penetrate CEREC porcelain so the dentist can see problems, if they develop**,** down the road. It is difficult to see what is happening under traditional metal or porcelain-to-metal crowns with dental X-ray.

Figure 7: When coping is completed, In-Ceram infiltration glass is applied

Figure 8: Coping is ready for ceramic application

Figure 9: Dentin, enamel and effect powders are applied in conventional manner, concentrating on tooth shape and development of natural occlusal anatomy

Figure 10: Ceramic is fired according to manufacturer's recommendations

Figure 11: Subsequent applications of ceramic made and fired to complete natural anatomical form

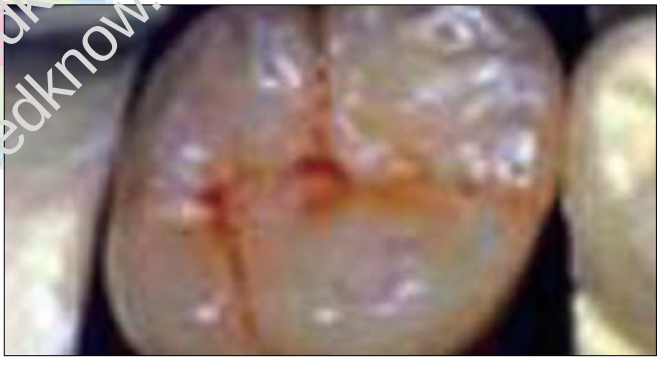

Figure 12: Restoration polished to create final surface characterization and luster

MATERIALS AND METHODS

Three materials are available for almost any clinical indication:

1. Spinell (350 Mpa) for highly aesthetic anterior crowns.
2. Alumina (525 Mpa) for translucent anterior and posterior crowns and 3-unit bridges.
3. Zirconia (750 Mpa) is ideal for high strength posterior crown and bridge frameworks.

The preparations should have clearly defined margins and inner edges.

Recommended cements for copings adhesive bonding or conventional cementation can be used.

OTHER USES OF CEREC

Fillings (inlays and onlays)

CEREC fillings (inlays and onlays) are superior to amalgam or composite fillings because of their superior aesthetics and strength. With enamel-like material**,** they

look and feel like real teeth and are longer lasting. And because they are metal free, CEREC onlays have a more natural look and feel and can help preserve healthy, natural tooth structure.

Veneers

Unlike composite veneers, CEREC uses enamel-like material that looks and feels more like real teeth.

Fabrication of tooth using CEREC[5]

After tooth preparation is completed, an impression, opposing cast and interocclusal records are taken. With the creation of master models**,** opposing casts are mounted in proper relationship. At this time we depart from traditional 'lost wax' techniques and move into the new world of digital dentistry. All case information is first entered into the computer**,** including the doctor, patient and teeth to be restored. Next the die is inserted into the scanning milling chamber to be automatically laser scanned [Figure 2]. This information is downloaded into the computer where the coping design phase takes place. Once the design is complete, the information is automatically uploaded into the milling machine and the appropriate milling block is selected and inserted into the block holder [Figure 3]. Milling of the coping is completed [Figure 4]. The milled coping is placed on the master die to verify fit [Figure 5] and the margins are finished to final thickness with rubber wheels [Figure 6].

In-ceram technique

When the coping is complete, In-Cream infiltration glass is applied [Figure 7] and fired to the manufacturer's recommendations. Excess infiltration glass is removed with aluminum oxide blasting. At this time, coping is ready for ceramic application [Figure 8].

Ceramic technique

Dentin, enamel and effect powders are applied using conventional techniques concentrating on tooth shape and development of natural occlusal anatomy [Figure 9]. Ceramic is fired according to manufacturer's recommendations [Figure 10]. Subsequent applications of ceramic are made and fired to complete natural anatomical form [Figure 11]. Restoration is then polished to create final surface characterization and luster [Figure 12].

CONCLUSION

Since the first patients had been treated with CEREC inlays in 1985 at the University of Zurich**,** from this time CEREC has undergone continuous technical and clinical developments. Today it is used worldwide by a growing number of dentists in their practices. With 15 years of research and development and more restorations placed than any comparable unit, the CEREC has earned its role in dental history as the technology that gives patients one of the finest restorations in the world in only one visit.

ACKNOWLEDGEMENT

I want to express my heartfelt thanks to my teacher and guide Dr. (Mrs) Kusum Datta for her timely help, support and guidance in the completion of this endeavour.

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Source of Support: Dr. Jatinder Singh,
Conflict of Interest: None declared.