

## Review Article

### Comparative Evaluation of Two Chairside CAD CAM Systems

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#### Abstract:

In the 1950s and 1960s when prototypes of computer aided design (CAD) and computer-aided manufacturing (CAM) were introduced into industrial settings. Early dreamers like Mörmann, Durret and colleagues and Rekow were intrigued by the possibilities of using CAD-CAM in dentistry continued to work, and CAD/CAM systems are now part of everyday dentistry<sup>1</sup>. The success of CAD CAM systems reflects in the fact that The CEREC CAD CAM system has been available commercially since 1986, is used by more than 17,000 dentists and in 28 dental schools in the United States, and has produced approximately 12 million restorations till date.

Keywords: CAD CAM, CEREC, E4D

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#### INTRODUCTION

In 1971 Durret for the first time introduced the concept of CAD-CAM (computer aided designing and computer aided milling) for fabrication of dental restoration. CAD CAM technology takes us one step further eliminating the procedures like impression making, model making and fabrication of temporary prosthesis.<sup>1</sup> Dentist controls the manufacturing of the restoration entirely without laboratory assistance. The use of CAD/ CAM system has helped provide void free porcelain restorations, without firing shrinkage and with better adaptation.<sup>2</sup> Glazing is the only thing required after milling the ceramic block. CAD-CAM cause minimal abrasion of opposing tooth structure because of homogeneity of the material as abrasion in these does not exceed that of conventional and hybrid posterior composite resins. Although numerous approaches to CAD/ CAM for

restorative dentistry have evolved, all systems ideally involve 5 basic stages:

- Computerized surface digitization
- Computer-aided design
- Computer-assisted manufacturing
- Computer-aided esthetics
- Computer-aided finishing

The last two stages are more complex and are still being developed for inclusion in commercial systems.

#### DISCUSSION

There are only two chairside restorative systems capable of generating complete restoration without laboratory help namely – CEREC and E4D. CEREC was developed before e4d by Brains A.G. in Switzerland and first demonstrated in 1986.<sup>3-6</sup> Whereas E4D came into existence in 2008. The only laboratory procedure required is glazing. Following is step by step comparison of two systems.

## Basic functioning

### The Optical impression



**Figure 1:** Blue cam ac

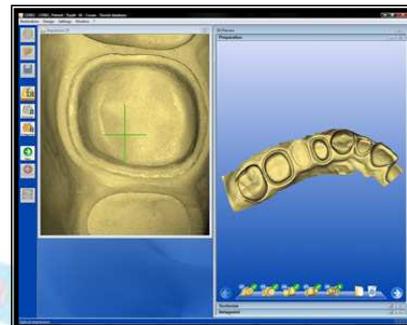


**Figure 2:** Red laser

- i. CEREC uses blue colored light emission technique to capture the data. Whereas E4D uses red colored LASER to scan the restorations.
- ii. CEREC uses titanium dioxide to reduce unnecessary reflection of light but E4D does not require any. Still 5% of cases reflected light from surface of tooth does not get captured.
- iii. CEREC does not require data which type of restoration to be fabricated, but in case of E4D it does requires data.
- iv. Speed of scan can be controlled in E4D but it is fixed in CEREC. In both systems manual and automatic scan option is available. But in case E4D it offers a rapid scan option whose speed can be controlled.
- v. The scan having undercut areas are shown in the blue in E4D but nothing like this exists in CEREC.

- vi. With new blue cam ac CEREC does not require any special stabilising equipment but E4D has two stabilisers for the laser.
- vii. For scanning impressions and models CEREC requires special materials but E4D scans impressions and models without requirement of any special material.

### Captured Data Analysis:



**Figure 1:** Computer generated image



**Figure 4:** ICE EVERYTHING

- i. CEREC uses usually three occlusal scans to make digital image but E4D requires 9 scans but delivers more accuracy than CEREC. E4D scans from distal to mesial on occlusal, buccal and lingual side.
- ii. If scan is correct it gives green color indicator to the image but if wrong it will give a red color in both the systems but in E4D scan shows a yellow color if it is almost correct.
- iii. E4D superimposes the images captured to give a 3D image which is life like image

by ICE EVERYTHING tool whereas in CEREC the images by new 3D software create 3D picture.

- iv. Trimming of the tongue etc has to be done in E4D but not in CEREC.

### Processing the Captured Image



**Figure 5:** Computer generated restoration

gives a near exact occlusal anatomy of the teeth.

- iv. There are three lines along with changes in shape and size can be made, any specific area selection tool is not present. In E4D area can be selected and can be manipulated by RUBBER TOOL.
- v. After completion of trimming of restoration ANTAGONIST function can be used to check for high points similarly E4D uses BITE scan to give high points.
- vi. E4D requires to align the restoration parallel to the red line in the proposal but in CEREC this is done during image capturing.

### Technical/ Mechanical Comparison



**Figure 6:** Rubber Tool and LASSO



**Figure 7:** CEREC – Milling Machine

- i. For marking the margins CEREC uses only lasso tool but in E4D there are two tools available color and lasso.
- ii. CEREC proposes the restoration based on the biogenic occlusion from the distal most tooth but E4D proposes on the data fed in the digital libraries. For the proposed restoration design changes can be made by rubber tool in E4D but in CEREC it is done by trim, drop and other commands.
- iii. In E4D the occlusal library are only two and have to be selected before scan starts. CEREC not only has wide range of digital libraries but it uses biogenic occlusion that



**Figure 8:** E4D- Milling Machine

- i. Full arch scan is possible with CEREC but in E4D only 16 teeth can be done.

- ii. 3 unit bridge can be fabricated with CEREC but it is not possible with E4D.
- iii. Subgingival scanning is not possible in CEREC but it is possible with E4D with OCT software.
- iv. CEREC MCXL mills faster as compared to E4D. It mills 39% faster than E4D.
- v. E4D displays more correct time it will take as compared to CEREC. Even on slow milling mode CEREC shows normal milling time.
- vi. During slow milling E4D burs broke or needed change in 16% cases. On milling with IPS empress needed 50% more burs.
- vii. Bur changing is automatic in E4D but not in CEREC.
- viii. CEREC milling machine needs continuous connection with CPU or design centre but in E4D it frees the design centre for next restoration.
- ix. CEREC restorations are lesser in strength as compared to E4D. 9% lesser in flexural strength when E.MAX and 6% in IPS empress.
- x. On interruptions like stoppage of water or air supply both need to be restarted. These incidences were less with E4D.
- xi. Price of CEREC is 109995\$ where as price of E4D is 116500\$. Distributor for CEREC is Patterson whereas for E4D its Henry Schein.

### CONCLUSION

From simple restorations to the fabrication of three unit bridges chairside CAD CAM technology has come a long way. It has inspired many new technologies and newer concepts in the dentistry to make it 21st century dentistry. It is the cost that is mainly acting as deterrent for this

technology to become a huge success. No automated system currently offers the flexibility with regard to restoration types and material choices that is possible with traditional fabrication methods. An emphasis on intraoral data acquisition scanners and digitizers is likely. This could lead ultimately to the elimination of impressions and stone models. It is likely that future digitizers or scanners will be more robust, facilitating accurate data capture despite the presence of saliva, soft tissue etc.

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