Review of Advanced CAD-CAM Technology used in Dental Implant Preparation

Mr. Pravin Dahalke[1], Mr. Swapnil Nawale[2] , Mr. Sharad Sakharekar[3] , Ms. Priyanka Nichat[4]
[1,2,3,4] Assistant Professor, Dept of Mechanical Engineering
[1,2,3,4] PHCET,Rasayani

Abstract- *In this article, we reviewed the history and recent development of dental CAD/CAM systems for the fabrication of crowns and fixed partial dentures. The use of dental CAD/CAM systems is promising not only in the field of crowns and FPDs i.e. manufacturing but also in other fields of dentistry, even if the contribution is presently limited. Finally some advancements regarding future perspective are briefly elaborated. Some technologies explained are CEREC, SIRONA, BLUECAM etc.*

Keywords- Dental CAD-CAM, CEREC, FPDs, DENTURES etc.

I. INTRODUCTION

Owing to the increased demand for safer and quick dentistry, new CAD-CAM methods, high strength Ceramic materials have been recently introduced. CAD/CAM systems have developed considerably, offering accuracy and more options than previously. It can be envisioned that CAD/CAM technology developments will continue to offer dentistry more options for its use, including further CAD/CAM integration of procedures and imaging enhancements. The first CAD/CAM system for the dental office was CEREC 1.

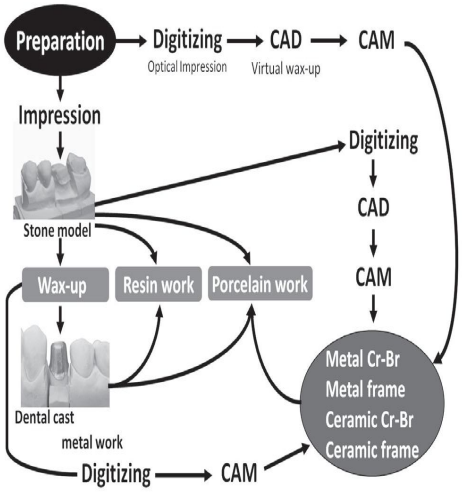

Figure. 1 An overview of current dental CAD/CAM systems using for the fabrication of crown-bridge restorations.

The system was developed by Prof. Dr. Werner Moermann in Switzerland and was eventually licensed to what today is Sirona Dental Systems. The most current version of the CEREC system is the new CEREC AC, a modular unit that contains an acquisition unit (Figure 1) and was introduced in January 2009. A separate milling unit (Figure 2) has evolved to allow it to fabricate virtually any type of individual restoration with ease and precision unmatched by its predecessors.

Fig. 2 Bluecam scanner

The main feature of the new system is the camera, which is referred to as the "Bluecam" and uses the blue spectrum of visible light and is the most accurate version fabricated. Bluecam uses blue-light light emitting diodes to create highly detailed digital impressions. A variety of CAD/CAM systems have been applied to the total process for fabricating restorations.

An overview of the current dental CAD/CAM systems used for the fabrication of crowns and FPDs is given. Integration of these technologies has resulted in the introduction of several highly sophisticated CAD/CAM systems: CEREC 3Db and inLabb; DCS CEREC 3Db and inLabb; DCS Precidentc; Procerad; Lavae; Cercon Smart Ceramicsf; Everestg; Denzirh; DentaCadi; and Evolution D4Dj.

Fig.3 CEREC AC unit

CEREC

With CEREC 1 and CEREC 2, an opticalscan of the prepared tooth is made with a couple charged device (CCD) camera, and a 3-dimensional digital image is generated on the monitor. The restoration is then designed and milled. With the newer CEREC 3D, the operator records multiple images within seconds, enabling clinicians to prepare multiple teeth in the same quadrant and create a virtual cast for the entire quadrant.

The restoration is then designed and transmitted to a remote milling unit for fabrication. While the system is milling the first restoration, the software can virtually seat the restoration back into the virtual cast to provide the adjacent contact while designing the next restoration.

Fig. 4 CEREC Connect

DCS Precident

The DCS Precident system is comprised of aPreciscan laser scanner and Precimill CAM multitool milling center. The DCS Dentform software automatically suggests connector sizes and pontic forms for bridges. It can scan 14 dies simultaneously and mill up to 30 framework units in 1 fully automated operation. Materials used with DCS include porcelain, glass ceramic, In-Ceram, dense zirconia, metals, and fiber- reinforced composites. This system is one of the few CAD/CAM systems that can mill titanium and fully dense sintered zirconia.

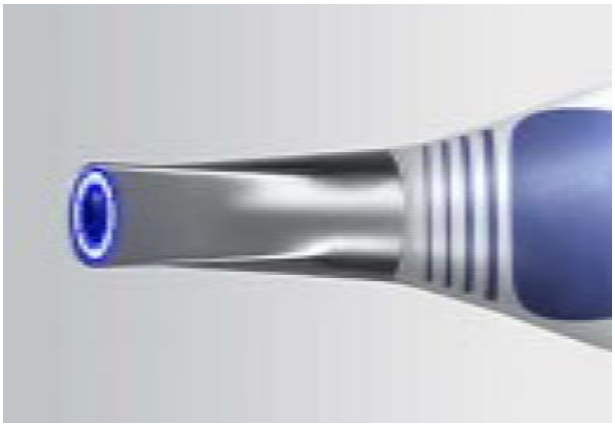

Fig. 5 LAVA COS

Procera

Procera/AllCeram was introduced in 1994and according to company data, has produced 3 million units as of May 2004. Procera uses an innovative concept for generating its alumina and zirconia copings. First, a scanning stylus acquires 3D images of the master dies that are sent to the

processing center via modem. The processing center then generates enlarged dies designed to compensate for the shrinkage of the ceramic material. Copings are manufactured by dry pressing high-purity alumina powder

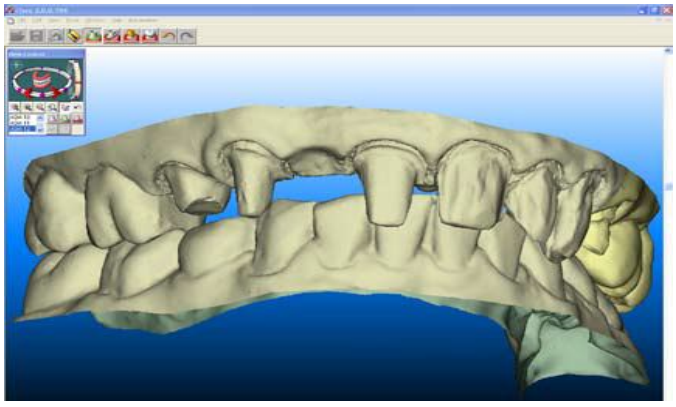

Fig. 6 iTero image

Lava

Introduced in 2002, Lava uses a laser optical system to digitize information from multiple abutment margins and the edentulous ridge. The Lava CAD software automatically finds the margin and suggests a pontic. The framework is designed to be 20% larger to compensate for sintering shrinkage. After the design is complete, a properly sized semisintered zirconia block is selected for milling. The block is bar coded to register the special design of the block. The computer- controlled precision milling unit can mill out 21 copings or bridge frameworks without supervision or manual intervention. Milled frameworks then undergo sintering to attain their final dimensions, density, and strength.

The system also has 8 different shades to color the framework for maximum esthetics.

Fig. 7 LAVA COS image

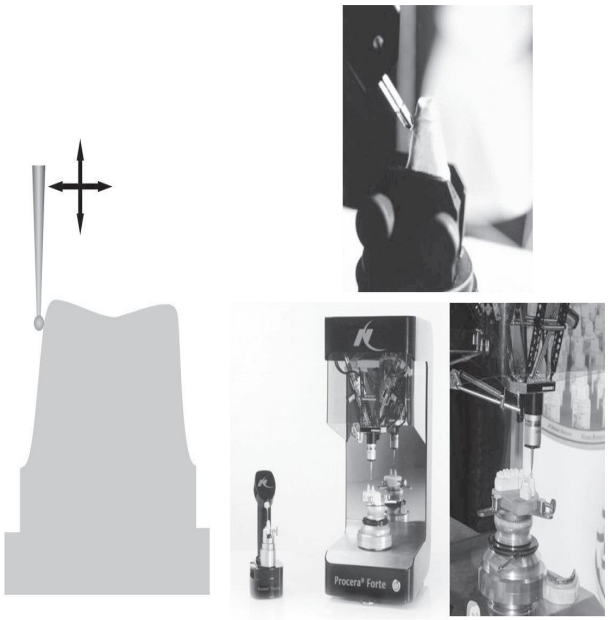

Fig. 8 Digitizing methods using contact probe

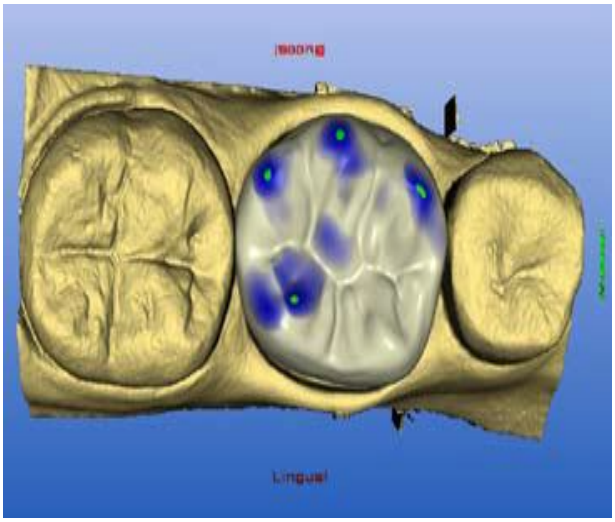

Fig. 9 Digital impression

Materials used in CAD-CAM dentistry

High strength ceramics have been developed as the core/framework material for all-ceramic restorations because of their improved esthetics and the eventual biological incompatibility risks of metals used for conventional porcelain-fused to metal restorations (PFM 1). Because of the improved mechanical properties, especially flexural strength and fracture toughness, lithium disilicate (Empress II ®), glassinfiltrated alumina (InCeram Alumina®), glassinfiltrated alumina with partially stabilized zirconia (In-Ceram Zirconia®), densely sintered high-purity alumina (Procera®) and yttria-stabilized tetragonal zirconia polycrystal materials

(Cercon®, DCSPrecident, and Lava) have been used as framework materials for all-ceramic FPDs.

Potential benefits of CAD/CAM systems

- Accuracy of impressions
- Opportunity to view, adjust and rescan impressions
- No physical impression for patient
- Saves time and one visit for in-office systems
- Opportunity to view occlusion
- Accurate restorations created on digital models
- Potential for cost-sharing of machines
- Accurate, wear- and chip-resistant physical CAD/CAM
- derived models
- No layering/baking errors
- No casting/soldering errors
- cost-effective

II. CONCLUSION

CAD/CAM systems have dramatically enhanced dentistry by providing high-quality restorations. The evolution of current systems and the introduction of new systems demonstrate increasing user friendliness, expanded capabilities, and improved quality, and range in complexity and application. New materials also are more esthetic, wear more nearly like enamel, and are strong enough for full crowns and bridges.

Dental CAD/CAM technology is successfultoday because of the vision of many great pioneers. There is no doubt that the application of CAD/CAM technology in dentistry provides innovative, state-of-the-art dental service, and contributes to the health and QOL of people in aging societies Therefore, we in the field of dentistry must not procrastinate in implementing new technology for the benefit of our patients.

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