



CAD CAM: THE FUTURE OF DIGITAL DENTISTRY

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KEYWORDS :

INTRODUCTION

CAD/CAM is an acronym for Computer-Aided Designing and Computer-assisted Manufacturing. Over the past 25 years, CAD/CAM technology has become extremely popular.

It is been widely used in dental laboratories and dental offices for accurate designing and fabrication of various restorations like inlays, onlays, crowns, veneers, implant abutments, cast removable partial dentures and even full mouth rehabilitation..CAD/CAM technology was introduced in dentistry in the year 1989, by Mormann & Brandestini in Germany[1]. The introduction and evolution of computer aided designing and manufacturing technology in dentistry has greatly revolutionized treatment concepts and prostheses fabrication.[2]

Advantages Of Cad/Cam System

1. No Traditional impression.
2. Produce Chair side restoration.
3. High precision and accuracy.
4. Improve the quality of restoration.
5. Speed, ease of use and quality Digital scans.
6. Faster design and fabrication.
7. Natural appearance of CAD/CAM restorations [3].

Disadvantages Of Cad/Cam System:-

1. Initial cost of the equipment and software is high.
2. The practitioner needs to spend more time and money in training.
3. Dentists without large enough volume of restoration will have a difficult time making their investment to provide refunds immediately [4].

History:

The first application of CAD-CAM technology was initiated and described by Duret and Preston, the pioneers of dental CAD-CAM technology in 1991 [5]. The 3D graphic reconstruction was done by optical impression (scanning of tooth preparation) using intraoral digitizer Mormann along with Dr.Brandestini manufactured a tooth coloured posterior indirect dental restoration which was called as CERAMIC RECONSTRUCTION and was popularly known to be CEREC in 1985.It is important in providing same day ceramic restorations [6]. Dr.Anderson developed procerasystem in 1983 , This has a central processing centre with satellite networking centre under this unit.

Objectives and potentials of the CAD/CAM technology

- It aims towards eliminating the traditional impression
- methods by designing and machining the restoration with
- the aid of computer; to produce chair-side restorations and
- finally to improve the qualities of restoration.[1,2,7]

Stages in prostheses fabrication with CAD/CAM technology

There are various stages in fabrication of the prostheses with CAD/CAM technology.

1. Computer surface digitization
2. Computer-aided designing
3. Computer assisted manufacturing

The first stage is the Computer surface digitization. This technique can be broadly divided into two categories:

1. Mechanical scanning devices.
2. Optical scanning devices.

Optical camera, LASER surface scanning device, three dimensional

(3-D) scanning device (digitizer), photogrammetry, Moiré fringe displacement, computed tomography (CT-Scan), magnetic resonance imaging (MRI), 3-D ultrasonography etc. are some of the technologies used for computer surface digitization. [8]

The next stage in CAD/CAM is Computer-aided designing (CAD). Once the 3-D image is captured through any of the computer surface digitization techniques, 3-D image processing is done and the digitized data is entered in the computer. Finally, curve smoothening, data reduction and blocking of undercuts can be done at this stage. Designing of the restoration is done using CAD software, which in turn send commands to the CAM unit, for fabricating the restoration.[2,5,9]

Third and the final stage is Computer-aided manufacturing (CAM). In this stage the milling is done with computerized electrically driven diamond disks or burs which cut the restoration from ingots. This process is commonly known as "subtractive method".[9]

CAD/CAM technology in fixed prosthodontics

CEREC in Lab system - The tooth preparation die is secured in the scanning platform and data is captured with a non-contact laser. A Ceramic block (ingot) is placed in the milling chamber. Two milling diamonds create the precise restoration. Porcelain build-up is done which results in an aesthetically pleasing restoration. Then the fit is confirmed in the patient's mouth and required adjustments are done.[6,7,10]

CAD/CAM technology in maxillofacial prosthodontics

CAD/CAM is widely used for the fabrication of maxillofacial prostheses, extraoral radiation devices, individual respiratory masks and facial protection devices etc. Three dimensional surfaces imaging is done by using CAD software. This 3-D surface image aids in the fabrication of resin model with Lithographic technique and then wax pattern is made. [11]

CAD/CAM technology in removable partial denture prostheses

Fabrication of cast partial dentures can be done using Co-Cr Alloys or commercially pure Titanium and Ti-6Al-4V Alloy by utilizing CAD-CAM technologies. Using CAD/CAM software the removable partial denture framework design is built on a three-dimensional scan of the patient's cast.[11,12]

CAD/CAM technology in implant prosthodontics

Computer usage in implant placement (Navigational technique) has increased in the past decade. Recently with the use of CAD/CAM application patient-specific abutments can be fabricated. These CAD/CAM fabricated custom abutments are designed by computer and manufactured by computer operated machines for obtaining unsurpassed accuracy and precision. As they are milled from medical-grade Titanium, they have superior biocompatibility and best possible integration with implant fixture. [13]

CAD/CAM technology in fabrication of surgical guides for implant placement

Bibb *et al* described the fabrication of stainless steel surgical guides for the placement of dental implants for prosthetic retention using SLM technology. It was first reported for the manufacture of custom-fitting surgical guides.[1,7,13]

COMPONENTS OF CAD/CAM:-

1. SCANNER/ DATA COLLECTING TOOL
2. DESIGN SOFTWARE
3. PROCESSING DEVICES

Scanner:-

1. It includes the data collection tools that measure three dimensional jaw and tooth structures and transform them into digital data sets.

Basically there are two different scanners

1. Optical scanner.
2. Mechanical scanner.

Optical Scanner :

1. It involves the collection of 3D structures in a so- called 'triangulation procedure'.
2. The source of light and the receptor unit are in a definite angle in their relationship to one another.
3. White light projections or a laser beam can serve as a source of illumination.

Eg :

1. Lava scan (3MESPE, white light projections)
2. es1 (etkon, laser beam)[6]

Mechanical Scanner :

1. The master cast is read mechanically line-by-line by means of a ruby ball and the three dimensional structure is measured.
2. The provera scanner from Noble Biocare
3. This type of scanner is distinguished by high scanning accuracy, whereby the diameter of the rubber ball is set to the smallest grinder in the milling system.[7,8]

Design Software

1. With such software, crown and fixed partial dentures, frameworks can be constructed.
2. Some systems offer the opportunity to design full anatomical crowns, partial crowns, inlays, inlay retained FPDs, and telescopic primary crowns.
3. The software available on the market is being continuously improved.
4. The data of the construction can be stored in various data formats.
5. The basic is standard transformation languages (STL) data. [9]

Processing Devices:

1. The construction data produced with the CAD software are converted into milling strips for the CAM processing and finally locked into the milling device.
2. Processing devices are distinguished by means of the number of milling axes; accordingly there are three types:
 1. 3-axis devices
 2. 4-axis devices
 3. 5-axis devices [12]

Summary:-

1. Newer CAD/CAM systems demonstrate increasing user friendliness, expanded capabilities, improved quality, and greater range in complexity and application.
2. Chairside digital impression systems allow for the creation of accurate and precise laboratory modules and restorations involving less chairside time.
3. CAD/CAM guarantees durability and reduces the risk of fracture.
4. Processing data can be saved and followed up during the functional period for the device.[14]

DISCUSSION:-

Dentistry has evolved from various old treatments such as crude restorations made of wires and wood to the new world of digital dentistry. CAD/CAM technology being one among them has resulted in precise fabrication of prostheses with less chance of error. in the patient's mouth and required adjustments are done. [15]

CONCLUSION:-

Even though the CAD/CAM system is costly initially, it ensures precise work and patient comfort. The advancement of CAD/CAM systems has developed to more precise levels. So we need to incorporate more of technologies to the field of dentistry for better future. [1,2,5,8,13,15]

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