

## **Cad/Cam In Prosthodontics**

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### **ABSTRACT:**

*CAD/CAM technology are being extensively used in engineering field because of their high precision and accuracy. These system have introduced to dental field in late 1980s and have started being used in various field of dentistry. This is an attempt to provide an overview for the application of CAD/CAM in the various branches of prosthodontics.*

**KEY WORD:** *CAD/CAM technology, Restoration, Dental prosthesis.*

### **INTRODUCTION:-**

CAD/CAM is an acronym for computer –Aided designing and computer assisted manufacturing , it is a scientific advancement in the field of dentistry and prosthodontics. Using it to improve the design and creation of dental restoration ,especially dental prostheses, including crown, veneers, inlays and onlays ,fixed bridges, dental implant restoration. Computer aided design and manufacturing were developed in the 1960s for use in the aircraft and automotive industries. CAD/CAM technology was introduced in dentistry in the year 1989,by Mormann & Brandestinni in Germany<sup>[1]</sup>. The introduction and evolution of computer aided designing and manufacturing technology in dentistry has greatly revolutionized treatment concepts and prostheses fabrication .The use of CAD/CAM was limited in the production of computer dentures due to the lack of suitable CAD software unit recently <sup>[2]</sup> .

### **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 <sup>[3]</sup>

### **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 <sup>[4]</sup>.

### **The Cad/Cam Process:-**

1. A CAD/CAM system utilizes a process chain consisting of scanning, design and milling phases.
2. The scanning device converts the shape of the prepared teeth into three dimensional (3-D) units of information into a 3-D map (point cloud).The operator designs a restoration shape using the computer which generates a tool path , which is used by the milling devices to create the shape from a restorative material. <sup>[5]</sup>

### **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 (3M ESPE, white light projections)
2. es1 (etkon, laser beam)<sup>[6]</sup>

### **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 procera 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.<sup>[7,8]</sup>

### **Desing 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.<sup>[9]</sup>

#### **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<sup>[10]</sup>

#### **MATERIALS FOR CAD/CAM:-**

1. Materials for processing by CAD/CAM devices depends on the respective production system.
2. Some milling devices are specifically designed for the production ZrO<sub>2</sub> frames, while others cover the complete palette of materials from resin to glass ceramics and high performance ceramics.
3. The materials normally processed by CAD/CAM systems include:
  1. Metals
  2. Resin materials
  3. Silica based ceramics
  4. Infiltrated ceramics<sup>[11]</sup>

#### **Cad/Cam System:-**

1. Chair side production/office-Based devices.
2. Laboratory Production.
3. Centralized fabrication in a production center.<sup>[12]</sup>

#### **Chairside Production:-**

All components of the CAD/CAM system are located in the dental clinic. Fabrication of dental restorations can thus take place at chairside without a laboratory procedure. The digitalization instrument is an intra oral camera, which replaces a conventional impression in most clinical situations. This saves time and offers the patient indirectly fabricated restorations in one appointment. Four products are presently available for digital impressions in the dental office: CEREC AC (Sirona, Charlotte, NC, USA)

E4D Dentist (D4D Technologies, Richardson, TX, USA).

Taking digital impression allows dentist to do away with selecting trays, mixing materials, and waiting for them to set, cleaning up the mess from the impression, disinfecting the impression, and transporting the impression to a laboratory. The application of powder to the tooth is quick and simple, taking only seconds, and the powder is easily removed afterwards with air and water. The E4D takes several images, using a red light laser to reflect off of the tooth structure and only requires the use of powder in some limited circumstances. The LAVA Chairside oral scanner takes a

completely different approach using a continuous video stream of the teeth. CEREC and LAVA currently require the use of powder for the cameras to register the topography.<sup>[13]</sup>

#### **Laboratory Production:-**

This variant of production is the equivalent to the traditional working sequence production between the dentist and the laboratory. The dentist sends the impression to laboratory where a master cast is fabricated first. The remaining CAD/CAM production steps are carried out completely in the laboratory. With the assistance of a scanner, three dimensional data are processed by means of dental design software. After the CAD-process the data will be sent to a special milling device that produces the real geometry in the dental laboratory. Finally the exact fit of the framework can be evaluated and, if necessary, corrected.

#### **Centralized Production:-**

The third option of computer-assisted production of dental prostheses is centralized production in milling center. In this variation, it is possible for 'satellite scanner' in the dental laboratory to be connected with a production centre via the internet. Data sets produced in the dental laboratory are sent to the production center for the restorations to be produced with a CAD/CAM device. Finally, the production centre sends the prosthesis to the responsible laboratory. Thus production steps 1 and 2 take place in the centre. This production model minimizes the cost to the laboratory and has the potential to improve fabrication efficiencies.<sup>[14]</sup>

#### **Recent Advances:-**

Initially, when CAD/CAM was introduced in dentistry, dental CAD/CAM system were restricted only to fabricated inlays, onlays, and single unit crowns but over the past few years, CAD/CAM have shown and proved their utility in restorative, prosthetic and pre-surgery dentistry. Dental CAD/CAM system allows the application of newer high strength biomaterials with adequate esthetics.<sup>[15]</sup>

#### **SUBTRACTIVE AND ADDITIVE TECHNIQUE:-**

1. Currently, subtractive milling is the most widely implemented computer-aided manufacturing protocol in dentistry and it has been shown to be a suitable method for fabricating intraoral prostheses.
2. Additive methods have the advantage of producing large objects, with surface irregularities, undercuts, voids, and hollow morphology that make them suitable for manufacturing facial prostheses and metal removable partial denture frameworks.<sup>[16]</sup>

#### **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.<sup>[17]</sup>

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 technology. William et al have demonstrated a method of fabrication of removable partial denture framework design using

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.<sup>[18]</sup>

### **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. The CAD/CAM fabricated custom abutment carries advantages like: - precision, milled from titanium, ideal coronal preparation, correct path of insertion, perfect emergence profile, 6° angled implant axis, shaped like a natural tooth and reduced chair time. Computerized designing of abutment is done and primary abutment is fabricated from commercially pure titanium via computerized-milling technique. Another duplicate abutment is milled, which is functionally identical to primary abutment, thus reducing chair time.<sup>[19]</sup>

### **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.

### **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.

### **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.

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