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Review Article

Digitalization of future dentistry -CAD-CAM

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ABSTRACT

The mid-1980s saw the introduction of CAD/CAM in dentistry, also known as computer-aided design and computer-aided manufacturing. There are two types of CAD/CAM restoration fabrication: chairside and chairside—laboratory integrated. The success of CAD/CAM technology is a result of significant breakthroughs in computer technology and dental materials during the past 20 years. We are now able to create and construct 3D models using computer numerical control (CNC) equipment that are based on virtual prototypes, thanks to the advancements in information technology. In the process known as computer-aided design (CAD), computers can now be utilised to produce precisely detailed projects that can be evaluated from several angles. To make virtual objects tangible with CAD

INTRODUCTION

Both the dentist and the patient use technology. The revolutionising of the way dentistry is practised and the manner in which dental laboratories are fabricating restorations. This technology, which is used in both the dental laboratories and dental office, can be applied to inlays, veneers, fixed partial dentures, implant abutments, even full mouth restorations and complete dentures. CAD-CAM is used in orthodontics in the form of Invisalign retainers. CAD-CAM designates the three-dimensional planning of a work piece on the screen of a computer with subsequent automated production by a computer-controlled machine too. The first generation of CAD-CAM was designated to fabricate immediate chair-side inlays and onlays ceramic restoration. Initial CAD-CAM technology, but they required an excessive amount of time for fabrication. This first generation of computer hardware and software offered a limited 2-dimensional view of scan images. The hard drive capacity was unable to store the large volume of data required for a 3-D view. Cad-cam, parts, and components can be designed and machined with precision using a computer with integrated software linked to a milling device. Cad-cam technology has already changed dentistry and will replace more and more traditional techniques in fabricating dental restorations.

History: Dr. Francois Duret was the first to develop the dental cad-cam in 1971. Dr. Mormann was the developer of the commercial CAD/CAM system. Dr. Anderson developed the Procera method of manufacturing high-precision dental crowns in 1983. He was also the first person to use CAD-CAM for composite veneer restoration. Dr. Rekow worked on dental cad-cam systems in the mid-1980s with colleagues at the University of Minnesota. It is used in the formation of inlays, onlays, veneers and crown implant abutments. In 1994, Siemens introduced the CERAC 2 unit.Cerec 3 was released in 2000, with a 3D operating system added in 2003. In 2012, Straumann introduced the Straumann crec CAD-CAM machine, which is more efficient than other machines, for the cerac3. Construction and control software was written for the WindowsNT and 2000 platforms.[1]

CAD-CAM components -There are two different scanning types: a) optical scanners, and b) mechanical scanners.

Optical scanners are devices that collect data from third-dimensional systems via a process known as "triangulation." Here, the receptor unit and the source of light (such as a laser) are seen from a certain angle. With this viewpoint, the computer can calculate a third-dimensional information set from the image at the receptor unit. A source of lighting can be either a laser beam or projections of white light. Optical scanners used in dental offices include the following: Example: Lava scan ST (3MESPE), Everest scan, ESOL.[2]

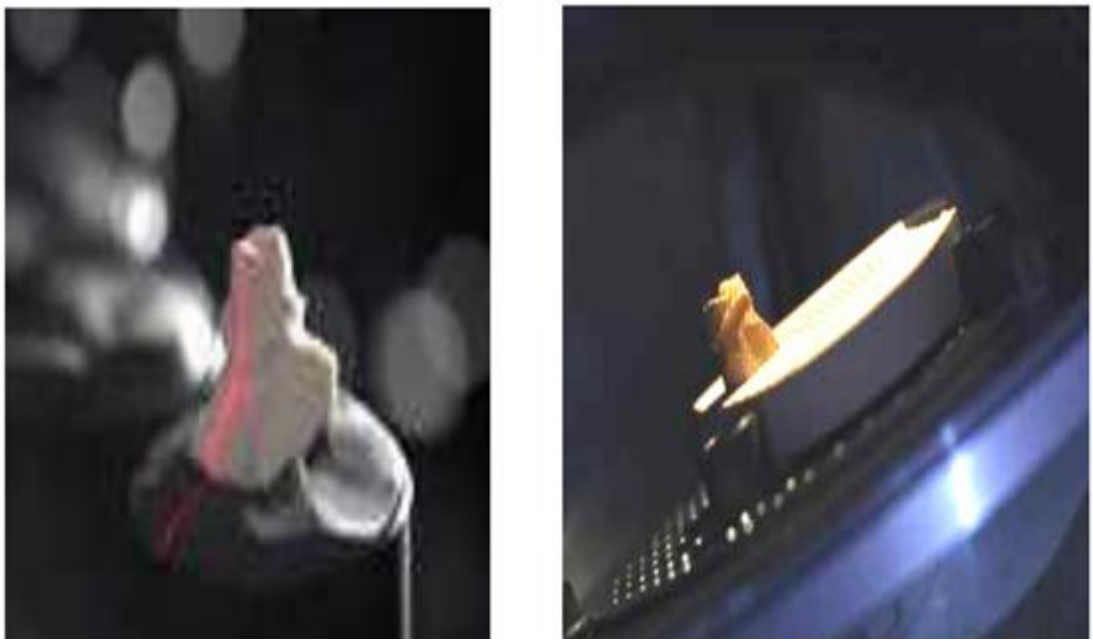

Fig. 1: Optical Scanner of CAD/CAM System

Mechanical Scanner: In this type of scanner, the third-dimensional shape is measured while the drawn shape is robotically observed line-by-line using a ruby ball. The most successful example of a mechanical scanner in modern dentistry is the Procera Scanner from Nobel BioCare (Göteborg). This type of scanner is distinguished by an extreme degree of scanning precision, in which the diameter of the diamond ball is prepared to the tiniest grinder within the milling apparatus, with the result that all information gathered by the apparatus may also be milled. The excessively complex mechanics of this data measurement technology, which result in a very expensive system and lengthy processing times compared to optical methods, are its main flaws.[2]

Fig. 2: Mechanical Scanner of CAD/CAM System

General Classification of CAD-CAM

1. Chairside **production:** At a single session, it provides the patient with an indirect manufactured restoration and saves time. In general, the Cerec system (Sirona) offers this chance. This system was the 1st CAD/CAM system and is presently the 4th latest generation accessible in markets. The benefit is the possibility of employing a software (3-D) programme and getting a precise reconstruction of the occlusal surface.

2. **Labrotary production:** It is comparable to how a dentist and technician would typically operate together. 3D data are created based on a master die. longer to complete than the first type. Let the technicians work more meticulously on the production of the final design.

3. **Centralised production:** over the Internet, satellite scanners are linked to a manufacturing hub. This is an open system, contrasted to other systems.[3]

Advantages of CAD/CAM and disadvantages
Compared to conventional methods, using CAD/CAM technology for dental restorations offers many benefits. These benefits include quickness, usability, and quality. Digital scans have the potential to be quicker and simpler than traditional impressions since they do not require casting, waxing up, investing, casting, or firing. The presence of a milling machine on the premises enables patients to obtain their permanent restoration the same day they visit without needing to schedule a separate appointment. Provisional restorations, which take time to create and fit, are no longer necessary for patients. If anaesthesia is required, it only needs to be given once. Since measurements and manufacturing are so accurate, CAD/CAM restorations have an extraordinarily high quality. Maybe there shouldn't be such a variation in the final output.[4]

Because the ceramic blocks are available in a variety of colours and have a transparent quality that mimics enamel, CAD/CAM restorations have a natural appearance. a variety of tones. Even when used for posterior teeth, ceramic lasts well in the mouth; less wear is caused to the neighbouring teeth by it since it is not more abrasive than traditional and hybrid posterior composite resins[4]. Because the prefabricated ceramic blocks are devoid of internal flaws and the computer software is made to generate forms that will withstand wear, the quality is constant.

Costs might be decreased through time and labour savings, and patients should be attracted by the promise of quick, high-quality restorations. Digital technology is well liked by patients since it rarely leaves them with queasy impressions. Another advantage is that all the scans may be saved on the computer, as opposed to the space-consuming and fragile traditional stone models that must be stored correctly. The computerised systems have flaws as well. The practitioner must invest time and money in training, and the equipment and software have a high initial cost. Without a sufficient number of restorations, dentists will struggle to see a return on their investment.

Similar to taking traditional impressions, the dentist has to take an exact optical scan of the tooth to create a perfect repair. The scan must replicate the adjacent and occlusive teeth and emphasise the end line. Similar soft-tissue care, retraction, moisture control, and haemostasis are as crucial for digital scanning as they are for traditional imprints.[3]

Due to the necessity for many stages, digital imprint systems may not save time as they are now employed. For instance, dentists who use certain scanners are required to transmit the photos for image cleaning before a dental technician sets the margins. The dental laboratory of the physician received the photos and checked them. Then a finished.[4]

The future implications of CAD/CAM technology Ultrasonic waves will be used to create ultrasound imprints in the future since they have the capacity to non-invasively penetrate the gingiva without retraction cords and are unaffected by blood, sulcular fluid, or saliva. As compared to optical impressions, this will result in significant improvements since it eliminates the need for thorough cleaning and drying of the oral cavity and related tooth structure, shortens treatment times, and improves patient comfort.[2]

CONCLUSION

Automatic fabrication processes provided by CAD/CAM technologies aid in standardising quality and speeding up production. Also, they could lessen the risks of cross-infections and improve the technique's accuracy. The dentist can employ more modern, high-strength materials with great biocompatibility, sufficient strength, and exceptional fit.Researchers have long wished for "the perfect CAD/CAM system." Due to the accuracy of CAD/CAM-made restorations in relation to all individual procedural and equipment faults and becausethe system's overall quality will be much improved by using a higher resolution scanner because scanning is the primary source of potential errors.

The use of new technology enhances the quality of services provided bythe practise of dentistry, as seen by patient satisfaction (95%). Prices for patients' accessibility are really good (91%). Regarding the matter of creating restoration.Patient satisfaction was 96% in brief. Patient satisfaction is 100 percent when the question of whether dental restorations give a natural sensation is asked. The new technological developments in oral medicine take on an aesthetic quality. The time it takes to create prosthetic work is considerably reduced when CAD/CAM technology is used, and CAD/CAM systems are simple to use.

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