

# EDITORIAL

## CAD/CAM technology to reshape your Dental Practice.

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The term 'CAD/CAM' in dental technology is currently used as a synonym for prostheses produced by 'milling technology'. CAD is the abbreviation for 'computer-aided design' and CAM stands for 'computer-aided manufacturing'.

Dental restorations produced with computer assistance have become popular in recent years. Most dental companies have access to CAD/CAM procedures, either in the dental practice, the dental laboratory or in the form of production centers. The many benefits associated with CAD/CAM generated dental restorations include: the access to new, almost defect-free, industrially prefabricated and controlled materials; an increase in quality and reproducibility and also data storage commensurate with a standardized chain of production; an improvement in precision and planning, as well as an increase in efficiency. As a result of continual developments in computer hardware and software, new methods of production and new treatment concepts are to be expected, which will enable an additional reduction in costs. Dentists, who will be confronted with these techniques in the future, require certain basic knowledge if they are to benefit from these new procedures.

All CAD/CAM systems consist of three components:

1. A digitalization tool/scanner that transforms geometry into digital data that can be processed by the computer
2. Software that processes data and, depending on the application, produces

a data set for the product to be fabricated

3. A production technology that transforms the data set into the desired product.

### CAD/CAM production concepts in dentistry

Depending on the location of the components of the CAD/CAM systems, in dentistry three different production concepts are available:

- chair side production
- laboratory production
- Centralized fabrication in a production centre.

#### a) Chair side production

All components of the CAD/CAM system are located in the dental surgery. Fabrication of dental restorations can thus take place at chair side 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 at one appointment. At present, only the Cerec<sup>®</sup> System (Sirona) offers this possibility. Other producers also plan to introduce chair side CAD/CAM systems to the market. Since the Cerec<sup>®</sup> system functions with water-cooling; a variety of materials can be processed, from glass-ceramic to high performance oxide ceramic. Clinical observations on ceramic inlays are available over a period of 21 years. Scientific literature reported success rates for CAD/CAM produced inlays of 90% after ten years and 85% after 12 and 16 years.<sup>1, 2, 3</sup> Historically, this system was the first CAD/CAM system in dentistry and is currently available in its third product generation. One of the benefits of this very

mature system is the software that has been supplemented by a very exact three-dimensional reconstruction of the occlusal surface.

### **b) Laboratory production**

This variant of production is the equivalent to the traditional working sequence between the dentist and the laboratory. The dentist sends the impression to the 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 produced on the basis of the master die. These 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 on the basis of the master cast.

### **c) Centralized production**

The third option of computer-assisted production of dental prostheses is centralized production in a milling centre. In this variation, it is possible for 'satellite scanners' 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 centre 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 dental laboratory, while the third step takes place in the centre.<sup>4, 5</sup> As a result, the configuration of the prosthesis remains in the hands of the dental technician. The benefit of outsourcing CAM production is to be found in the small investment requirement, since only the digitalization tool and software have to be purchased, still having access to a high quality production process. In addition, this procedure results in greater independence, since there is no relation to a particular production technology (such as, eg milling technology). It must, however, be noted that presently almost all CAD/CAM systems are only available as closed systems. In other words, if one acquires a

scanner from one manufacturer, this implies, in the case of a closed system, that there is only access to that manufacturer's processes and line of products. In addition, the dental laboratory loses the income from producing the framework, since it is fabricated in the production centre.

Many production centers also offer laboratories without a scanner the possibility of sending the master cast to the centre for scanning, designing and fabrication. The additional veneering of the frameworks for prosthetic restorations is carried out in the dental laboratory.

Recently, dentists have been offered the possibility of sending the impression directly to the production centre. This application is presently limited to ceramic inlays only.

An additional simplification in CAD/CAM production consists of intraoral data collection (optical impression). This means a digitalization of what is now only an 'analogue' step in the production process. This could lead to additional improvement in quality and cost reduction. New software developments will make it possible to directly judge the quality of the preparation intraorally, before data are finally sent to the dental laboratory or production centre.

### **Evaluation – advantages and disadvantages of computer-assisted production**

CAD/CAM technologies have started a new age in dentistry. The quality of dental prostheses has improved significantly by means of standardized production processes. This makes very efficient quality management possible. On the one hand it increased the productivity tremendously and changed dental laboratories from manufacturers to modern computerized production centres. On the other hand this increase in productivity leads to a competitive capability to produce dental prostheses independent of the manufacturing site, which might be a major factor for the high wage countries to keep business volume in the country. Last but not least CAD/CAM technology has made it possible to machine interesting new materials like the high

performance ceramics and titanium with high accuracy.

However, some drawbacks of this fabrication technology have to be mentioned. The high investment for machines might overextend the budget of smaller laboratories. Some

applications are limited due to software and production procedures.

CAD/CAM technology has already changed dentistry and will replace more and more of the traditional techniques in fabricating dental restorations.

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