EUROPEAN INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND MANAGEMENT STUDIES

TYPE Original Research
PAGE NO. 7-12
DOI 10.55640/eijmrms-05-12-03

Application Of Computer And Digital Technologies In Contemporary Dentistry

Turumova Marjona Bahodir kizi

Assistant of the Department of Orthopedic Stomatology of SamSMU, Samarkand, Uzbekistan

OPEN ACCESS

SUBMITTED 20 October 2025
ACCEPTED 12 November 2025
PUBLISHED 17 December 2025
VOLUME Vol.05 Issue12 2025

Abstract: Digital dentistry represents one of the most rapidly developing areas of modern medical science, significantly transforming diagnostic, therapeutic, and preventive approaches in dental practice. The integration of computer-based technologies, including computer-aided design and manufacturing (CAD/CAM), digital imaging, intraoral scanning, three-dimensional modeling, and artificial intelligence, has enhanced the accuracy, efficiency, and predictability of dental procedures. These technologies allow for precise diagnosis, individualized treatment planning, and minimally invasive interventions, thereby improving clinical outcomes and patient satisfaction. Furthermore, digital workflows contribute to the optimization of clinical time, reduction of human error, and standardization of dental procedures. This paper analyzes the current applications of computer equipment and digital technologies in dentistry, highlighting their clinical advantages, limitations, and future prospects. The findings emphasize the growing importance of digital dentistry as an essential component of innovative medical practice.

Keywords: Digital dentistry; Computer technologies; CAD/CAM systems; Intraoral scanning; Digital imaging; Dental diagnostics; Treatment planning.

Introduction: Digital dentistry is a dental treatment technology that uses computer systems and equipment. Today, this area is actively developing, and new-generation clinics are beginning to use modern devices. Computer scanning is used at the diagnostic stage, as well as for creating dental casts, modeling, and prosthetics. CAD/CAM techniques are being especially actively implemented.

Digital dentistry is an innovative field in medicine that makes extensive use of computer software. This makes it possible to get the greatest effect and maximum

aesthetics in the treatment of diseases of the dental system. Important components of this approach are comfort during diagnosis and treatment, as well as obtaining a result that is more long–term than using less advanced technologies.

Innovations are most noticeable in orthopedic dentistry, because the success of implantation or installation of metal-free prostheses is already unthinkable without modern technology. However, the methods of digital dentistry are no less in demand in other industries, when adjusting the bite, eliminating the dysfunction of the temporomandibular joint.

How is technology adoption and integration taking place in dentistry?

Despite all the visible advantages of the digital approach, the adoption and integration of such technologies is slow. Top managers are intimidated by the need for material investments. Since the cost of dental treatment based on the use of computer technology is higher than alternative methods, a quick return on investment is questionable in terms of investments.

It will be possible to reduce the cost of this process and make procedures as accessible as possible for all segments of the population using software created by AVANTIS 3D, a Russian developer. In addition, in this case, a full course of study in working with the program is guaranteed, as well as other types of cooperation are offered. Those clinics that have taken advantage of the offers from AVANTIS 3D are already profiting from innovations in orthopedic dentistry in 2019, recording a significant increase in the flow of patients.

What are the advantages of digital dentistry?

Digital technologies in dentistry provide a number of advantages. These include:

• The possibility of carrying out all stages of dental treatment at a qualitatively new level, which implies ensuring high accuracy of restorations, a long warranty period, and impeccable aesthetic properties;

• Visualization of the course of orthopedic treatment on a computer monitor, discussion of interim results with the patient, selection of the most acceptable;

• Maximum quality implantation, which is achieved by accurate diagnosis and creation of surgical templates;

• Ensuring high-quality orthodontic treatment, its implementation unnoticed by others, using transparent removable aligners, lingual braces;

• The ability to accurately determine the parameters of the functioning of the temporomandibular joint by creating a virtual model, which greatly simplifies and improves the quality of therapeutic measures in this area.

CAD/CAM and intraoral imaging

Innovations in orthopedic dentistry are most significant due to the introduction of CAD/CAM technology. It is a process that combines computer modeling with the subsequent manufacture of orthopedic products according to specified parameters, which ensures prosthetics at a qualitatively new level. In this case, a result is achieved that is not available with other technologies. The CAD/CAM system is used for manufacturing:

• crowns, veneers and ceramic inlays made of ceramic and zirconium dioxide;

• bridge-like structures;

• temporary crowns, which are produced in the shortest possible time.;

• Abutments and surgical templates where high precision is required.

The diagnostic stage is the use of a scanning device, which is a compact video camera. Through intraoral imaging, the specialist can examine the tooth image in detail on the monitor.

In the future, through the application of the "smile design" module, the future shape of teeth is designed, taking into account not only the initial parameters of the tooth, but also the individual characteristics of the patient, movements of the lower jaw. This allows you to create real prosthetics that will prove to be impeccable not only for their functionality, but also for aesthetics and harmony with the entire appearance.

The production stage, carried out using a milling machine and provided with a computer program, is equally flawless in its clarity. The resulting model perfectly matches the set parameters. With this approach, the fitting only confirms the accuracy of all the actions performed. The need for behavioral corrective measures is excluded. The fixation of the manufactured prosthesis is the final stage.

The cost of purchasing a CAD/CAM system in dentistry is often a deterrent to its widespread use. Despite the competition, foreign brands producing this equipment maintain high prices. A significant advantage of the CAD/CAM system from AVANTIS 3D soft is its more attractive cost compared to imported analogues, as well as the possibility of providing a full course of training in working with it.

Diagnostic technologies

Computer technologies are widely used in diagnostics. In a modern clinic, a patient can appreciate new methods from the first visit. To prescribe medical

procedures and make a treatment plan, the doctor needs to assess the condition of the patient's dental system. Therefore, a scan is performed, with which you can:

• make an accurate diagnosis;

• discover all the problems that are often impossible to identify visually;

• take measurements that will help you create crowns and other procedures in the future.;

• provide the patient with the maximum level of comfort.

Visual diagnostics does not guarantee comfortable conditions for the patient and does not ensure the accuracy of diagnosis. Outdated methods are no longer used in many areas of dentistry. Digital equipment has another advantage — all the results can be saved in a database.

New generation implantation

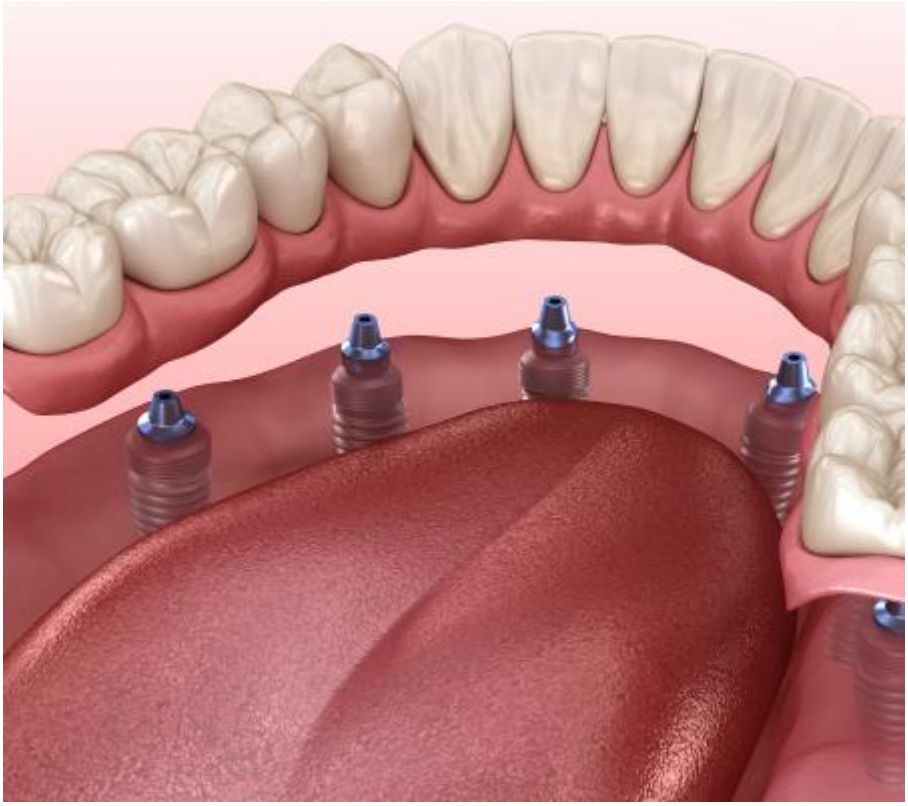
• when creating dental implants;

• in the diagnosis of the dental system;

• in the manufacture of temporary and permanent crowns;

• when performing operations.

Implantation involves the use of a CAD/CAM system, which is used to work with veneers, abutments, crowns, bridges, various onlays and surgical templates. CAD/CAM technology combines the procedure of modeling and subsequent manufacturing. This allows you to achieve high accuracy in the manufacture of models.



Other areas of application

Digital dentistry is developing not only in the field of implantation, but also in the correction of bite and other defects. 3D scanning allows you to get the most accurate information about the condition of the jaws, proportions, and the presence of injuries. Today, special programs are used in information systems that make it possible to assess the patient's health status. The programs use an extensive database to perform diagnostics and calculations.

Intraoral scanning, which is used during various dental surgeries, deserves special attention. After such a scan, special thin mouth guards are made for straightening teeth, as well as guides for implantation. The manufacturing process and the accuracy of the data no longer depend on specialists — everything happens automatically. The use of computer technology ensures:

• High quality of services;

• Maximum comfort for the patient;

• Transfer of data via a secure protocol to the clinic's database;

• Quick solution of urgent tasks;

• Help even in difficult cases.

What is the difference between new generation crowns?

Many patients who have gone through the bite correction procedure remember the old mouth guards.

To make them, it was first necessary to make an impression of the patient's teeth. This is a procedure that few people have been enthusiastic about. Then it was necessary to make a model based on the impression and send it to the dental laboratory. In the laboratory, it was used to create a special removable bite correction device that needed to be adjusted regularly at home.

According to the old technology, mouth guards were made using a special machine. This took up time and affected the quality of the caps — they were thick, uncomfortable and caused unpleasant sensations. Modern models are made automatically without an impression. All parameters of the dental system can be obtained by scanning. This guarantees the highest precision when creating crowns. Moreover, the mouth guards are very thin, they can imperceptibly affect the position of the dentition. After a while, one design is changed to another, making slow progress. These are the fruits of the computer revolution in dentistry.

The dental field of aesthetic medicine has undergone major changes in recent years. Today, no one is afraid to visit a dentist's office when it comes to a modern clinic. Visits to such an institution are quite a pleasant event, because pain during treatment has become a rarity today. Thanks to digital technologies, you can get rid of a lot of unpleasant and routine procedures.

The main application of technology

Computer technologies are particularly widely used in three areas of dentistry:

• prosthetics;

• implantation;

• Orthodontic treatment.

The installation of dental implants is a rather complicated procedure, in which it is important to take into account many variables. The correct location of the implants, the accuracy of their installation, and the manufacture of structures with the most accurate dimensions are of fundamental importance. Computer technology allows you to achieve the perfect result. It is simply impossible to achieve such accuracy using other methods. It was thanks to the introduction of digital equipment that the implantation procedure was brought to a new level.

Orthodontic treatment deserves special attention, which requires a thorough diagnosis of the maxillary region. Previously, outdated methods were used that did not give accurate results. There was an error, therefore, the results of treatment did not always lead to the desired result.

Orthodontic treatment includes not only the correction of the position of the teeth, but also covers a broader area. However, in 90% of cases, patients turn to an orthodontist to correct the bite. For this purpose, special mouth guards are used, which are printed based on the results of a preliminary intraoral scan. Intraoral scanning can also be used in other areas.

How did this affect the cost?

Many patients may think that digital dentistry is expensive. Has the use of computer equipment increased the prices of treatment? Practice shows that the cost of treatment has only decreased. There is a rational explanation for this. Before the introduction of new technologies, many procedures were time-consuming. There were serious demands on the doctors who performed the procedures. Clinics took risks — an expensive procedure could lead to a negative result.

Today, the human factor in diagnostics and procedures is reduced to zero. A lot depends solely on the software of modern devices. Next-generation devices can provide precision that humans can never achieve. Many processes have been automated and simplified. In dental laboratories, the manufacturing process is also automated.

This has led to a reduction in the cost of procedures. The clinic invests in equipment at the first stage, after which it benefits from the use of new equipment. Patients also benefit from this — procedures have become noticeably more accessible and safer. Today, the percentage of successful implantation procedures reaches 100% due to:

• new diagnostic technologies;

• application of the latest materials;

• the use of software in predicting treatment outcomes;

• high precision in the manufacture and implementation of implants.

Patients can undergo implantation on the most favorable terms. Also, with the help of new technologies, tabs are successfully made and help with the installation of bridges.

What new technologies provide

Digital dentistry continues to evolve and is bearing fruit. Procedures are simplified, and patients feel completely safe when visiting clinics. Specialists have to regularly master new equipment and work with software systems. However, technology rather simplifies the dentist's life. After all, in the past, you had to do a lot "by sight", relying only on your own experience. In addition, the equipment performs most routine procedures, including processing diagnostic results, drawing up drawings, and preparing various dental devices.

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