



USE OF MODERN COMPUTER TECHNOLOGIES IN THE TREATMENT AND DIAGNOSIS OF DENTAL DISEASES

Ataxanov Sanjarbek Anvarovich
Fergana Institute of Public Health,
Assistant Lecturer, Uzbekistan

Ruzieva Rahnamo Behzod qizi
Fergana Medical Institute of Public Health,
1st-year student, Faculty of Pediatrics, Uzbekistan

Abstract

This article discusses how modern computer technologies help dentists treat teeth, take accurate dental images, detect hidden diseases, design crowns and prostheses, use lasers instead of drills, make diagnoses, as well as print teeth and models on 3D printers. The main methods are described: digital X-ray, 3D imaging, lasers, systems for manufacturing crowns and prostheses. An example of a practical assignment for students is given, as well as recommendations on using these technologies in education and practice. All of this makes treatment fast, accurate, and almost painless. The article explains how exactly computers assist dentists, provides an example of a practical assignment for students, and offers advice on using technologies in study and work.

Keywords: dentistry, computer, digital X-ray, 3D model, CAD/CAM, 3D printing, laser, telemedicine, diagnostics, treatment.

Introduction

Modern medicine and biology are among the most dynamically developing areas of science. Information technologies play an important role in their development. Accordingly, the need to teach students how to use these technologies is also increasing. Dentistry today is not only the treatment of teeth using traditional methods but also the use of an entire complex of computer technologies. Modern developments have made this branch of medicine much more precise, safe, and comfortable for the patient. Modeling biological problems in medicine helps not only to absorb theoretical knowledge but also to develop practical skills. Modeling



clinical situations with the use of computer technologies contributes to a better understanding of educational material, the development of practical skills, and critical thinking among students. This article examines the main directions of digital technologies in dentistry and their importance for the training of specialists of a new generation.

Main Part

The use of computer technologies in dentistry has become an important direction in modern medicine. Today, digital tools are applied at almost every stage of dental care: from diagnosis and planning to treatment and follow-up. Their use allows doctors to increase accuracy, shorten treatment time, and make procedures safer and more comfortable for patients. For dental students, learning these technologies is especially important because they are becoming the basis of their future professional work.

1. Computer Technologies in Diagnostics

Diagnosis is the first and most important stage of treatment. Modern digital technologies have completely changed this process. Previously, for diagnosing diseases of the teeth and jaws, doctors used conventional X-ray films. This method only allowed to see a flat image, and often some details remained invisible.

Digital Radiography

Today, digital radiography is used more and more often. Digital radiography is a modern diagnostic method that has gradually completely replaced film-based X-ray images. Unlike the old technology, where the image had to be developed on film, digital X-ray uses special sensors. They immediately transmit the information to a computer, and the doctor receives a ready image within a few seconds.

Advantages of Digital Radiography

1. High image quality. The image can be enlarged, rotated, brightness and contrast adjusted. This makes it possible to see even the smallest defects: the onset of caries, inflammation at the root tip, small cracks, or changes in bone tissue.
2. Minimal radiation dose. With digital X-ray, radiation exposure is 5–10 times lower than with traditional images. This is much safer for the patient, especially if several studies are needed in a short period of time.
3. Speed and convenience. The image appears on the computer screen immediately after shooting, so the doctor can instantly evaluate the result and, if necessary, take another image.



4. Archiving and data accessibility. All images are saved in the patient's electronic record. This is convenient for subsequent visits: the doctor can compare new and old images and track treatment dynamics.

5. Compatibility with other technologies. Digital images can be easily used together with computer programs for implant planning, orthodontic treatment, or surgical operations.

6. Environmental friendliness. With digital radiography, there is no need for chemical processing of film, as before. This eliminates the use of harmful reagents and makes the method safer for the environment.

Cone-Beam Computed Tomography (CBCT)

Cone-beam computed tomography is a modern diagnostic method that allows obtaining a three-dimensional image of teeth, jaws, and surrounding tissues. Unlike conventional X-rays, which show only a flat projection, CBCT shows the object from different sides and makes it possible to examine it in all details.

Features and Advantages of CBCT:

1. Three-dimensional visualization.

The doctor receives a volumetric model of the teeth and jaws. This helps not only to see the overall picture but also to evaluate the depth, shape, and position of roots, to detect hidden pathologies that cannot be seen on a conventional image.

2. Accuracy of diagnosis.

With CBCT it is possible to detect inflammatory processes at the root apex, cysts, granulomas, microcracks, and changes in bone tissue. This is especially important in complex cases when standard X-rays do not provide complete information.

3. Treatment planning.

Implantation. Tomography allows accurate measurement of bone volume and density, determining the optimal place for implant placement, and minimizing the risk of complications.

Wisdom tooth extraction. Thanks to the 3D image, the doctor sees the position of the tooth relative to nerves and blood vessels, which makes the operation safer.

Orthodontics and surgery. CBCT helps assess the structure of the jaw, the position of tooth buds, and bite anomalies.

4. Educational value. For students of dental faculties, CBCT is a valuable learning material. 3D images help to better understand the anatomy of the maxillofacial area, study rare pathologies, and analyze clinical cases.

5. Comparison with classical X-ray. A regular X-ray gives only one projection, and some details may remain hidden. CBCT forms a full 3D image that can be rotated, enlarged, and viewed from any angle. At the same time, the radiation dose of CBCT



is lower than that of conventional medical CT, which makes the method more gentle for the patient.

6. Digital data processing. The obtained images can be stored in the patient's electronic record, used for computer modeling of treatment, and demonstrated to the patient.

Computer Programs for the analysis of Radiographic and Tomographic Images

Modern technologies are actively being introduced into dental practice, and computer programs for processing and analyzing images occupy a special place here. Such programs work with digital X-ray images and CBCT data, helping the doctor to make diagnoses faster and more accurately.

The main features of such programs include highlighting suspicious areas on images and automatically recognizing possible diseases. This reduces the chance of mistakes and makes diagnostics more reliable. In addition, software is used for treatment planning and also plays an educational role by allowing students to learn from real cases. An important advantage is integration with patients' digital records, which ensures convenient storage and access to medical information.

2. Digital Technologies in Treatment

After making an accurate diagnosis, the next stage begins — treatment, and here digital technologies have significantly changed dental practice. Modern methods allow working faster, more precisely, and more comfortably both for the patient and for the doctor.

CAD/CAM Systems

CAD/CAM (Computer-Aided Design / Computer-Aided Manufacturing) are technologies that have made prosthetics maximally accurate and fast.

Previously, to make a crown or an inlay, traditional impressions were taken using silicone or alginate materials. This process was unpleasant for the patient (causing gag reflex and discomfort) and not always accurate. Today, instead of impressions, an intraoral scanner is used. It is a small camera that creates a three-dimensional (3D) model of teeth and jaws. Based on this digital model, the program calculates the exact shape of the future crown or inlay.

Then, a special milling machine or 3D printer manufactures the construction from ceramics or other materials. The entire process takes only a few hours, and the patient can receive a finished crown the same day, without repeated visits.



Laser Technologies

Lasers are increasingly used in dentistry, gradually replacing the traditional dental drill in some procedures. They are applied in many areas of treatment. With their help, decayed tissue can be removed without drilling, making the procedure more comfortable for patients. In surgery, lasers are used to work with soft tissues, such as gum reshaping or removal of growths. They are also used to sterilize root canals during endodontic treatment, reduce tooth sensitivity, and speed up healing of tissues after interventions.

3D Printing in Dentistry

3D printing in dentistry is a modern technology that allows creating precise and comfortable products for patients. With its help, dentists can produce crowns, bridges, surgical templates, clear aligners, and educational jaw models. Such devices make treatment more accurate and faster, and doctors can prepare better for procedures in advance.

For education, 3D printing is also very useful. Students can practice on copies of teeth and jaws, improving their skills without risk for patients. This makes training safer and more effective. As a result, the technology improves both treatment quality and the professional training of future specialists.

3. Online Courses and Webinars in Dentistry

In modern dentistry, online courses and webinars are becoming increasingly widespread. This format gives students access to advanced knowledge and the experience of specialists from around the world.

The self-study method allows choosing a convenient time, filling in knowledge gaps, and learning modern diagnostic and treatment approaches.

Online courses and webinars provide not only theoretical knowledge but also introduce the latest technologies and methods, making training more flexible and effective.

Laboratory Classes

Laboratory classes in biological modeling give students the chance not only to deepen their theoretical knowledge from lectures but also to see how it is applied in practice. This form of learning helps to better understand the structure of living systems, study the laws of their functioning, and find solutions in different situations.

Practical experiments allow students to develop skills in analyzing data, drawing conclusions, and applying knowledge to solve real tasks. Such classes also help to develop research skills and important professional qualities. Work in the lab teaches



accuracy, attention, responsibility, and independence, as well as showing how modern technologies can be used to study biological processes.

Group work is also important: students learn to interact, share ideas, assign roles, and reach common goals.

Thus, biological modeling plays an important role in the educational process. It helps students not only strengthen knowledge and critical thinking but also develop creativity, research ability, teamwork, and practical skills that will be useful in future professional and scientific work.

Conclusion

Studying biological modeling allows students to achieve several important results that make education more complete and practice-oriented.

Integration of Theory and Practice

Modeling helps connect theoretical knowledge with real examples. Students can better understand biological processes and medical procedures, as well as see how they appear in practice. This makes learning easier and more effective. It also gives students confidence in applying knowledge and prepares them for practical work.

Development of Analytical Skills

During modeling, students learn to work with data, analyze results, make decisions in different situations, and develop critical thinking. These skills are essential for future specialists in medicine and biology. They also learn to search for and compare different solutions, which is important when dealing with unusual cases and clinical problems.

Innovative Approach

The use of modeling in education introduces students to modern technologies and methods. It helps them not only to master new tools but also to develop flexible thinking, which is vital in healthcare where new approaches and solutions constantly appear. Another advantage is the ability to adapt to changes and be ready to use new technologies in professional practice.

Therefore, modeling biological processes plays a key role in student training. It develops critical thinking, the ability to work with modern technologies, apply knowledge in real situations, and solve complex professional tasks. This experience makes education more interesting and motivating, and better prepares students for real professional work.



Recommendations

1. Integration of Modeling Technologies into Educational Programs

Including biological modeling in the curriculum will help students better understand complex topics and processes that cannot be fully explained only with words or textbooks. Such technologies make learning more visual, engaging, and practical.

2. Support from Teachers

Teachers play a key role in learning new methods. It is important not only to explain how to use modeling, but also to help students adapt to new forms of study. Teacher support increases student confidence, interest, and motivation. Teachers can also encourage independent learning by showing the direct connection of new knowledge to future professional work.

3. Development of Teamwork Methods

Group work during modeling helps students learn to collaborate, share responsibilities, and find solutions together. This approach teaches them to listen to others, respect different opinions, and find common ground. Team activities develop both critical thinking and communication skills, which are very important for professional practice.

4. Use of Additional Resources

It is recommended to combine laboratory modeling with online courses, webinars, and modern digital platforms. This gives students more opportunities to strengthen their knowledge and revise material at any convenient time. Such a comprehensive approach makes learning more flexible and effective.

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